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Executive Summary

Increasing visitation rates within Bathurst Harbour and Bathurst Channel in the Tasmanian Wilderness World Heritage Area have led to concerns that the unique and fragile marine invertebrate communities found there during recent studies may be irreversibly damaged unless the nature and location of threats were identified and managed. An important component of the management process is the establishment of a monitoring program to quantify the biological assemblages present and to detect any human impacts to these assemblages if they occur.

This study has successfully established a quantitative baseline dataset on the horizontal and vertical distribution of invertebrate and algal assemblages within Bathurst Channel for use in on-going monitoring of change in the system. Robust estimates of the abundance of most conspicuous species have been obtained at selected sensitive sites (usually on hard substrates), allowing future changes and impacts to be detected and quantified. By utilising a combination of comprehensive quantitative surveys throughout the system and detailed habitat mapping, our understanding of the biological zonation within the system has been enhanced, along with our understanding of the limited extent of habitat available to many of the unique invertebrate assemblages.

Specific recommendations arising from this study include:

1. ensuring baseline monitoring continues at an appropriate time-frame (perhaps every five years)
2. gaining a more detailed understanding of the faunal assemblages that occur within the soft sediment habitats that form the vast majority of cover within Bathurst Channel.
3. completing a biological census of the marine species of this area initiated in 1993, to ensure that where possible the distribution and abundance of unique, rare and endemic species can be adequately identified and mapped in subsequent surveys.

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1. Introduction

The Bathurst Channel section of the Bathurst Harbour to Port Davey estuarine system has recently been recognised as having a unique assemblage of marine flora and fauna, primarily structured by the presence of strongly tannin stained water emanating from freshwater runoff (Edgar 1990, Last and Edgar 1994, RPDC 2002). The tannin stained waters severely restricts light penetration, with consequent constriction of the depth range able to be occupied by algal species. This has follow-on effects for marine invertebrates with the elimination of competition for space with algae and the almost complete absence of light, allowing normally deepwater species to occupy much shallower habitats. Characteristic species include lace bryozoans, seapens, soft corals and seawhips. The benthic invertebrate fauna is dominated by filter feeding groups such as corals, bryozoans, tube worms, ascidians and sponges, while marine groups such as molluscs, crustaceans and echinoderms are relatively depauperate (Last and Edgar 1994). This fauna is unique within the entire coastal zone of Australia. The only other documented assemblage with any similarity is found in Fjordland, New Zealand, where a similar occurrence of strongly tannin stained waters in coastal estuarine systems results in a constricted photic zone and dominance of species such as black corals, seapens and brachiopods in depths of less than 15m (Schiel and Hickford, 2001). The black corals in Fjordland are endemic to the area (Miller 1997), suggesting the unique and isolated nature of these tannin associated habitats may result in a high level of endemism relative to remaining coastal areas. Within Bathurst Channel/Bathurst Harbour one endemic fish has already been identified (*Raja* sp. L, Last and Stephens 1994) and a recent museum collection of invertebrates from this region suggests many new species may yet be described from this system (Last and Edgar 1994). The high conservation value of this area is widely recognised and this has led to the development of a proposal to protect it within a marine protected area (Edgar 1984, RPDC 2002) that has recently resulted in it being formally declared as a no-take marine reserve.

The mix of rare and potentially endemic species, coupled by the restricted and fragile nature of habitats found within Bathurst Harbour/Bathurst Channel are potentially threatened by a number of human impacts, including nutrification of the oligotrophic system, disturbance by scuba divers, and mechanical damage due to wake, wash and anchoring of vessels. To detect impacts and to help protect these fragile systems from future impacts and serial degradation, a quantitative baseline survey of the invertebrate and algal assemblages of this area was undertaken in Spring 2002. The survey focussed on accurately describing the percentage cover of species and assemblages present at a number of sensitive locations throughout the system for reference against future studies, and detailed mapping of the major marine habitats present. An additional component of the study involved description of assemblages at a number of other locations within the system so that spatial patterns in the vertical and horizontal distribution of species throughout the estuary could be formally and quantitatively described, extending the conceptual model discussed in Last and Edgar (1994) within a more quantitative and extensive framework.

2. Methods

2.1 Quantitative video survey

Undertaking quantitative transects of the marine life in Bathurst Channel associated with benthic habitats required a methodology that allowed rapid determination of the cover of common species at a wide range of locations and depths, in a time period limited by available funding and vessel support. The use of underwater video transects and video photographing of quadrats was considered to be the most appropriate technique available for the task and had the added advantage that a permanent video record would be produced for future reference.

In the initial proposal, six sites within Bathurst Channel considered to have high conservation value were selected for survey (Eve Pt, Joan Pt, Little Woody Island, Munday Island, Forrester Point, Sarah Island and Waterfall Bay), with at least two transects undertaken at each site to ensure that a reliable quantitative baseline was established for each site for future monitoring of change. During the survey itself, several additional sites were added to allow a more detailed description of longitudinal and depth trends throughout the system. These new sites included sites at Bramble Cove and Breaksea Island in Port Davey at the western end of the Bathurst Channel system, and at Platypus Point at the eastern end of Bathurst Channel.

The survey was undertaken in October –November 2002 with access to the area provided by the TAFI research vessel "Challenger". At each site, between 1 and 4 video transects were undertaken to adequately document and describe the benthic assemblages present and the variability within the site. Site positions and number of transects surveyed per site are shown in Table 1, and the site locations are shown in Fig. 1. Transect positions within each site were recorded using GPS, and the first section of each video was used to record an image of the shoreline where the transect was situated so that future surveys could be positioned accurately. At each site individual transects were laid perpendicular to the shoreline with the zero metre mark situated as close as possible to the average high tide mark. A diver was used to swim the transect reel offshore until the 20m depth contour had been reached or until the end of the transect line was reached, whichever came first. The transects were 100m long, and were marked every 5m with distinctive markings so that position along the transect could be interpreted from the subsequent video recordings.

Following deployment of the transect line, the diver swam back to the shoreline along the line, recording the depth every 5m so that the depth profile of each transect could be determined and these depths correlated with the video record. Once the transect line was deployed, a second diver entered the water and swam along the line, recording the benthic assemblages encountered on a Sony TRV 900 digital video camera housed in an Amphibico underwater housing. There were two components to the video record. The first component involved swimming slowly along the length of the transect line at a distance of approximately 70cm above the substrate to record the general assemblages present and any changes visible along the depth gradient. This methodology is similar to that used in a 1993 survey of selected sites in Bathurst Channel (Last and Edgar 1993) and was repeated at most of the 1993 sites (see Table 1 for details) to allow

future comparisons between the assemblages present between years. The video recorded during the previous study was collected as part of this study and DVD copies were made to provide a permanent record.

The second component of the video record involved the planned use of the video camera to take digital images of the assemblages and substrate within a 0.5m x 0.5m quadrat placed on the seabed. It was intended to take replicate photo-quadrat images at each of a number of characteristic depths along each transect line. These depths included 2m, 5m, 10m, 15, and 20m. It was also intended to take between 10-20 replicate quadrat images at each depth to obtain an adequate representation of the mean abundance of characteristic components of the assemblage present when the images were processed in the labs and scored for percentage cover. During video use at Eve Point on the first field day, it was found that the distance required between the camera and the quadrat necessary for the camera to remain in focus was inappropriate for using photo-quadrats in the tannin stained waters of Bathurst Channel. Despite optimal placing of video lights, the tannin in the water between the camera and the quadrat provided strong attenuation and distortion of light from the substrate that prevented adequate resolution of species and substrate types. The technique was therefore modified in-situ to allow the camera to be placed closer to the substrate. The modified technique required the video camera to be swum very slowly at a height of between 50 and 70cm above the substrate and oriented vertically. It was swum over a similar area at each depth that would have been sampled if quadrats were used. During processing back in the labs, still images were grabbed from the video footage obtained by this method using a video-capture programme *DVD tools* by “Pinnacle Systems”. Approximately 10-20 replicate quadrats were captured at each “core” depth (2,5,10,15,20m) on each transect at each site, with additional depths being recorded at some locations to provide further description of the sites, particularly relating to species hot-spots or the lower limit of the reef substrate if that fell between core depths. The depths where additional images were taken also include 0, 0.5 and 1m at many sites to describe the algal flora usually present in these zones. All still images used for the preparation of the data presented in this report are attached as a CD (Appendix A).

Video swims to record video for the photo-quadrat analysis were undertaken as part of the overall swim along the transect line. The depth of each photo-quadrat swim was usually indicated by the diver placing an appropriate number of fingers in front of the camera at the beginning of the swim as the diver departed from the transect line. The diver always returned to the same location on the line before continuing to the next ”core” depth to ensure a complete video record was available along each transect line.

Following capture of still photo-quadrat images, from each site, transect, depth and replicate, they were imported into the computer program “Powerpoint” and a grid with 50 points was superimposed over each image. A point intercept method was then used to estimate the percentage cover of species, lower level taxonomic groupings and substrate type. The number of points intercepted per species or grouping, was multiplied by 2 to give total percentage cover. While the total area within each photo-quadrat is variable due to the inability of the diver to maintain a fixed distance from the substrate, the use of percentage cover as an index of abundance means that scale is relatively unimportant as long as a suitable area is searched at each depth, there is sufficient replication, and objects were not generally too distant to be identified.

Table 1 Site positions and details of depth profiles of transects surveyed by video in Bathurst Channel in October/November 2002.

						Depth at position along transect line (m)																			
Site code	Site	Transect	Date	Latitude	Longitude	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
2	Breaksea Island	1	1/11/2002	43.33566	145.96544	3	4.4	6	6.8	7.4	8.3	8.8	9.2	9.8	9.8	11									
3	Milner Head-Bramble Cove	1	1/11/2002	43.32439	145.9868	0.5	2.3	5	6.3	8.1	9.1	9.3	9.7	10	11	11									
4	Sarah Island	1	30/10/2002	43.33257	145.99421	1.7	4.4	5.7	7.2	8.2	9	11	11	12	12	13	14	15	16	16	18	20	22		
4	Sarah Island	2	30/10/2002	43.33107	145.99284	1.7	3.3	4.3	5.9	7.2	8.5	10	11	12	12	14	16	17	17	18	18	19	21		
4	Sarah Island	3	30/10/202	43.33175	145.99363	2.5		4.3	4.8	5	5.5	6	6.4	7.2		8.9	9.9	13	14	16	13				
5	Waterfall Bay	1	30/10/2002	43.33664	145.9908	4.3	5.4	7	7.6	7.7	7.8	7.8	7.8	7.6	7.6	7.6	7.2	6.9	6.9	6.8	6.8	6.4	6.4	6.4	6.3
5	Waterfall Bay	2	31/10/2002	43.33728	145.99196	1	2.2	3.8	4.1	4.1	4.8	5.2	5.8	6.6	7.4	7.6	7.6	7.7	7.7	7.6	7.5	7.3	7.1	7.1	6.9
5	Waterfall Bay	2 extension	31/10/2002	43.33728	145.99196		6.6		6.5		6.4		6.8		6.8		7.4		8.1		8.7		9.9		11
5	Waterfall Bay	3	31/10/2002	43.33388	145.99	1.1	3.2	5.1	5.9	7.6	9.2	9.9	9.9	10	10	10	9.8	9.7	9.4	9.4	9.4	9.4	9.6	9.8	9.8
6	Beabey Point	1	30/10/2002	43.33826	145.99706	1	2.1	4	5.1	5.6	6.6	7.8	8.8	9.8	10	11	12	12	13	14	14	15	16	16	17
7	Forrester Point	1	29/10/2002	43.34125	146.00532	1	2	4.4	6.3	7.3	8.3	10	14	17	19	22									
7	Forrester Point	2	29/10/2002	43.34099	146.00521	4.6	8.7	13	16	20	23														
7	Forrester Point	3	31/10/2002	43.34146	146.00525	2.2	3.7	4.8	6.5	9	12	13	15	17		19									
8	Munday Island	1	29/10/2002	43.33986	146.00703	1.3	3.3	4.7	6.6	8.9	11	14													
8	Munday Island	2	29/10/2002	43.34018	146.00736	2	4.4	6.5	8.8	12	14	18	19	21											
9	Little Woody Island	1	27/10/2002	43.34059	146.04935	0.6	2.1	4.7	8.1	11	14	16	17												
9	Little Woody Island	2	27/10/2002	43.34066	146.04886	2		6		7.5		9		10			11		12		13				
9	Little Woody Island	3	28/10/2002	43.34082	146.04736	0.8	2.9	4.2	7.2	9.4	12	13	14												
10	Joan Point	1	28/10/2002	43.34333	146.0844	0.8	1.4	2.6	3.9	5.7	8.6	9.9	11	12	13	15	19								
10	Joan Point	2	29/10/2002	43.34361	146.08508	1.4	2.1	2.1	2.8	4.4	5.3	5.3	5.3	5.3	5.3	5.8	7.4	8.3	9.3	9.8	10.3	10.7	11.5	12.3	12.8
10	Joan Point	3	29/10/2002	43.34358	146.08409	1.0	2.1	2.8	4.1	5.5	6.1	8.0		9.5		11.6	13.1		16.4		18.9	20.5			
11	Eve Point	1	27/10/2002	43.34769	146.10033	2.5	5	6.5	8				10												
11	Eve Point	2	27/10/2002	43.34746	146.10057	1		5		10		13	15	19		25									
11	Eve Point	3	27/10/2002	43.34741	146.09964	1.9	4.6	8.2	10	12	15	19	20												
11	Eve Point	4	31/10/2002	end of Pt into channel		2.2	3.7	5.6	8	11	12	14	15	20	22										
12	Pt to east of Eve	1	31/10/2002	43.34973	146.10514	1	1.5	3.3	4.7	6.9	8	9.1	9.6	10											
13	Platypus Point	1	28/10/2002	43.34967	146.12443	2.3	6.1	8.8	12	14	19	21	24												

In many cases life forms could not be identified to species level from the still images. In such cases they were placed in a category which best describes them from the perspective of anyone subsequently examining the results. For example sponges with a recognisable growth form were placed into categories such as “orange finger sponge”, or “vase sponge” and reference images of each growth form were made for reference during future studies. Commonly a large proportion of the substrate within quadrats appeared to be effectively bare, overlain with a fine sediment cover, a layer of epifauna consisting of hydroids and bryozoans with a filamentous structure or a matrix of both fauna and sediments. In this situation the substrate was recorded as bare reef, however, where an epifaunal cover was evident it too was recorded, and given a code as additional epifaunal cover. With the exception of common species identifiable from images in current texts, reference images were taken of all species, life forms and substrate types identified and they are attached to this report as a CD or DVD (Appendix B). Each of these is identified by a reference code which is used in the database derived from the results and in the tables within the report showing the percentage cover of each species/grouping at each site and transect. All data obtained from examination of the photo-quadrats was entered onto an Excel spreadsheet (used as the database) with columns for site, transect, depth, replicate, species code, and estimated percentage cover. This database is held by TAFI and the Nature Conservation Branch of DPIWE (World Heritage Area Zoologist) for future reference. Due to time constraints not all transects and images were included in the final analysis. Eve Point Transects 1 &2 and Waterfall Bay T3 were processed for photo-quadrat still images but these were not subsequently analysed for percentage cover. The unprocessed images are included in the Appendices as Appendix C.

All video collected during this study was transferred to a DVD format suitable for viewing on current DVD players. This format is MPEG2. This format should be durable and allow for reliable archiving of these images for future use in a format that is in common use and that allows the highest possible reproduction of the original digital video recorded on mini-digital video tapes. Two copies were made of each video tape used, with one copy being lodged with the TAFI habitat mapping video archive and the other copy being lodged with the DPIWE Library.

2.2 Habitat mapping

An additional component of this study was to undertake detailed habitat mapping of the Bathurst Channel and Bathurst Harbour region while a suitable support vessel (“Challenger”) was in the area. Over a period of five days field mapping was undertaken from a small (5m) vessel when weather conditions were suitable. A detailed description of the methods used is given in Barrett *et al.* (2001). In simplified form, a differential GPS giving very high positional accuracy and a high quality depth sounder/sonar were connected to a laptop computer running a specially developed software program that logged position and depth at set time intervals. The time interval used was once every two seconds. The area to be surveyed (Figs 5-8) was crossed by the survey vessel navigating a search grid of approximately 200m between onshore-offshore and longshore tracks, producing a depth vs position data matrix from which depth contours were generated using dedicated software. While underway, the substrate

type (reef, sand, silt) was estimated from the depth sounder/sonar image by the operator and entered onto the laptop computer along with the corresponding position and depth. Determinations of substrate types were regularly calibrated via the use of an underwater video camera connected to a surface monitor and video recorder on the vessel. The images obtained by the video were recorded and depth/position stamped for future reference. To visualise typical habitats and habitat type by depth, selected video clips were embedded within habitat maps presented in Appendix D on the CD/DVD supplied with this report.

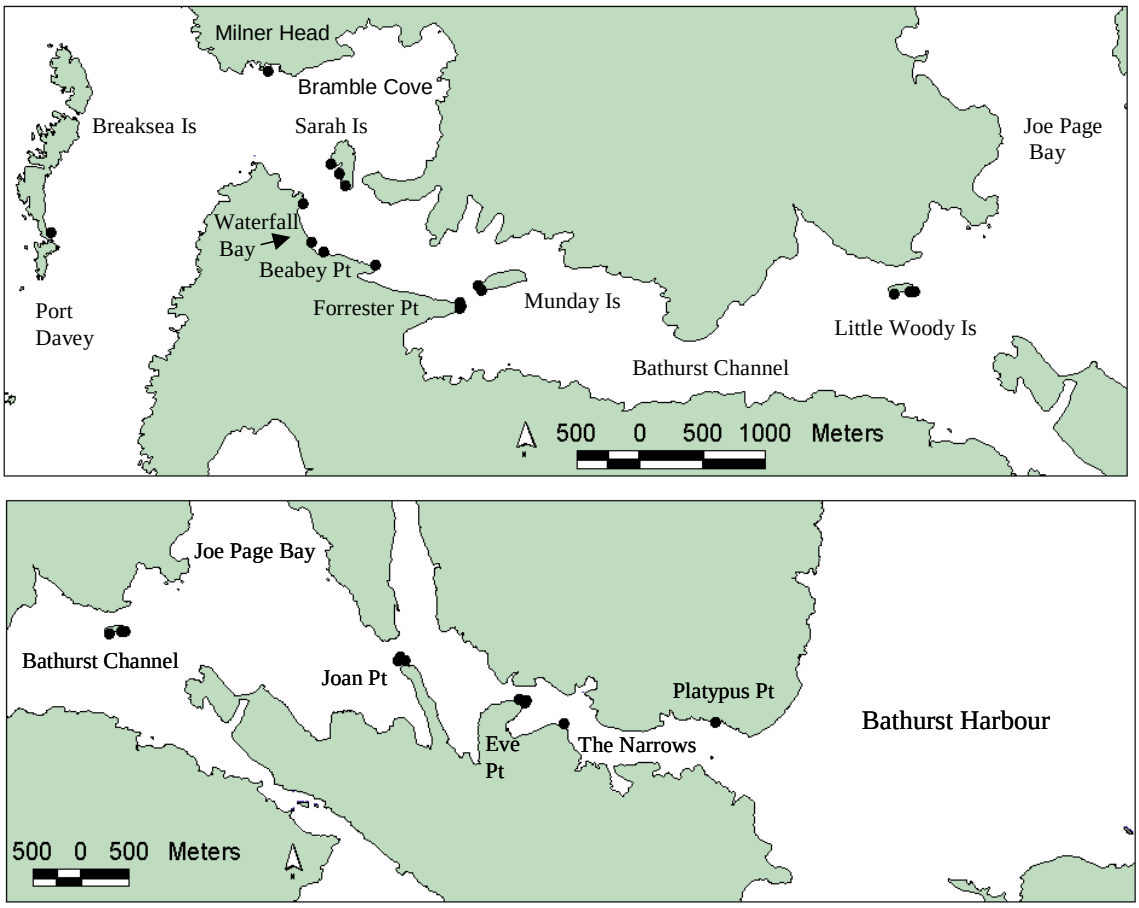

Figure 1. Location of sites and transects surveyed by video in the Bathurst Channel region of south-western Tasmania in spring 2002.

3. Results

3.1 Site descriptions

Examination of the distribution of assemblages within the Bathurst Channel system revealed distinct horizontal and vertical zonation. At the seaward end of the system on the inner protected shore of Breaksea Island, macroalgae dominated the reef assemblage to the outer reef margin at 7m, while at the survey depth of 5m algae accounted for 96% of the total reef cover (Table 2). Dominant algae included the brown algae *Durvillaea potatorum* in the first metre, *Phyllospora comosa* in the second metre, *Ecklonia radiata* in the third metre, with the low flat red algae *Sonderopelta coriaceae* common at 5m. This assemblage indicated that the site was subject to moderate exposure, sufficient to maintain the presence of *Durvillaea* but not to the 10+ metre depths found on the highly exposed outer coast of Port Davey (Barrett *et al.* 1998). The quick succession from brown algae to red algae by 5m depth indicates that the tannin water outflow from Bathurst Channel is sufficient to substantially alter the algal assemblage at this site from that found on the northern outer section of Port Davey where the water is clear, and where brown algae dominate the flora to below 10m depth (Barrett *et al.* 1998). At this site the lower reef margin was bounded by sand, rather than the fine sediments found in much of the adjacent Bathurst Channel.

At the next site surveyed eastwards (Bramble Cove) the increasing level of tannins, coupled with a slight decrease in exposure, lead to a compression in the algal-dominated zone with *Durvillaea* being restricted to less than one metre depth and being replaced as the dominant species by *Carpoglossum confluens* between 1-2m (Table 3). Below this, at 5m, the red algae *Thamnoclonium dichotomum* was the dominant species and it was the only algal species at 10m. *Thamnoclonium* has a commensal association with a sponge, allowing it to exist at light levels below those able to be tolerated by other algae that rely solely on photosynthesis. Within the Bathurst Channel system a complete gradient appears to exist within this species with shallow water plants being highly red pigmented and deeper specimens having no pigment at all. Specimens without pigment were classified as sponges.

By 5m depth the total algal cover at Bramble Cove had reduced to only 13%, being replaced by sponges as the dominant group, with cup sponges being the most conspicuous component. One notable feature of this site and one repeated eastwards through the system was the high proportion of bare reef below the photic zone. At 5m depth this was 70% while at 10m it was 67%. Often the “bare” reef was covered with a fine layer of filamentous hydroids and possibly bryozoans (not able to be readily identified from the captured images) representing an epifaunal component, however these were not structural and were easily swept away with a divers glove. This layer has a substantial component of trapped sediment and could not be readily separated from sediment in the images examined. At the reef margin below 10m the substrate was predominantly sand.

Tables 2-25. The following figures show the mean percentage cover and standard error of species, species groupings or substrate types relative to depth recorded from photo-quadrats captured from video transects undertaken during the baseline video survey of Bathurst Channel and adjacent coastline in October/November 2002. The number of photo-quadrats used for each estimate is also given. The photo-quadrats used in the analysis, and photos of reference images relating to species codes are included as images on a CD attached to this report as appendix A and B respectfully.

Table 2. Quantitative estimates of cover vs depth at Breaksea Island. Transect 1

		Depth (replicates)	1m (3)		2m (8)		3m (10)		5m (11)		10m (6)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	car	*Carpoglossum confluens*	0	0	2.57	2.41	3.6	2.68	14.4	6.52	0	0
	dur	*Durvillea potatorum*	81.3	9.4	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	7.71	4.7	21.8	7.4	17.5	4.78	0	0
	les	*Lessonia corrugata*	0	0	6	5.02	0	0	0	0	0	0
	mel	*Melanthalia obtusata*	0	0	0	0	10.4	6.23	4.18	3.62	0	0
	phy	*Phyllospora comosa*	3.33	3.33	44.3	13.6	0	0	1.27	1.27	0	0
	tha	*Thamnoclonium dichotomum*	0	0	0	0	1	1	1.64	1.17	0	0
Algae-red	enc	Encrusting corralines	0	0	14	5.02	30	7.63	34.7	5.08	0	0
	red	*Red rock. Peysionella spp?*	0	0	6	3.24	9	3.45	11.6	2.88	0	0
	son	*Sonderopelta coriaceae*	0	0	0	0	8	4.13	8.91	4.22	0	0
	tre	Thallose red algae	10	10	1.43	1.34	0.2	0.2	1.64	1.64	0	0
Total algae			94.7	0	82	0	84	0	95.8	0	0	0
Sponges	spo	Sponge u/i usually flat	0	0	0	0	1.6	0.93	0.91	0.62	0	0
Other cover	uid	Unidentified cover	0	0	0	0	0	0	3.82	3.82	0	0
Substrate	bre	Bare reef	0	0	18	6.51	13	5.34	0	0	0	0
	san	Sand	0	0	0	0	1.4	0.95	0	0	100	0
Total substrate			0		18		16		4.73		100	

Table 3. Quantitative estimates of cover vs depth at Bramble Cove Transect 1

		Depth (replicates)	0.5m (3)		1m (6)		2m (11)		5m (19)		10m (16)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	car	*Carpoglossum confluens*	0	0	55.7	6.18	62.9	8.3	0	0	0	0
	dur	*Durvillea potatorum*	90	10	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	2.67	2.67	14.9	8.7	0	0	0	0
Algae-red	enc	Encrusting corralines	5.33	5.33	38	8.1	18.4	2.75	0.11	0.11	0	0
	red	Red rock. *Peysionella* spp?	0	0	0	0	0.91	0.62	0	0	0	0
	tha	*Thamnoclonium dichotomum*	0	0	0	0	0	0	12.7	3.76	2.75	1.61
	tre	Thallose red algae	0	0	0	0	0.91	0.91	0	0	0	0
Total algae			95.3		96.3		98		12.8		2.75	
Cnidarians	soc	Soft coral	0	0	0	0	0	0	0.22	0.15	0	0
	whi	Seawhips	0	0	0	0	0	0	0.67	0.39	0	0
Total cnidarians			0		0		0		0.89		0	
Sponges	cus	Cup sponge	0	0	0	0	0	0	6	1.53	3.75	1.36
	cus2	Cup sponge. Spiral form.	0	0	0	0	0	0	1.22	0.69	1.88	1.88
	fso	Finger sponge-orange	0	0	0	0	0	0	0.33	0.24	1.25	0.87
	jhs2	Jokers hat sponge	0	0	0	0	0	0	0.22	0.22	0	0
	sp11	Large grey sponge, spines	0	0	0	0	0	0	0.22	0.22	0	0
	sp2	Sponge finger, very fine white/grey	0	0	0	0	0	0	0	0	1.25	1.25
	spo	Sponge u/i usually flat	0	0	0	0	0.36	0.36	5.33	0.42	1.13	0.41
Total sponges			0		0		0.36		13.3		9.25	
Echinoderms	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0.89	0.57	0.13	0.13
	pent	*Pentagonastar dubeni*	0	0	0	0	0	0	0.11	0.11	0	0
Other Cover	breb	Fine hydroid/bryozoan layer	0	0	0	0	0	0	69.4	3.92	67.1	6
	uid	Unidentified cover	0	0	0	0	0	0	1.56	1.51	0	0
Substrate	bre	Bare reef	4	4	3.67	3.67	1.64	1.17	69.4	3.92	67.1	6
	cob	Cobble	0	0	0	0	0	0	0	0	6.25	6.25
	san	Sand	0	0	0	0	0	0	1	0.59	14.5	4.44
Total substrate			4		3.67		1.64		70.4		87.9	

Table 4. Quantitative estimates of cover vs depth at Sarah Island Transect 1

		Depth (replicates)	0.5m (5)		1m (7)		2m (8)		3m (15)		5m (20)		10m (20)		15m (21)		20m (10)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	bro	Brown algae unidentified	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0
	car	Carpoglossum confluens	0	0	32	12.2	39.5	12.4	24.3	9.6	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	26.3	12.9	21.5	9.4	1.47	1.47	0	0	0	0	0	0	0	0
	mac	*Macrocystis pyrifera*	0	0	23.4	15.6	0	0	0	0	0	0	0	0	0	0	0	0
	xip	*Xiphophora gladiata*	74.4	12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae-green	ulv	*Ulva* spp.	10.8	6.97	0	0	0.75	0.75	0	0	0	0	0	0	0	0	0	0
Algae-red	enc	Encrusting corralines	0	0	8.29	4.1	8.25	2.79	5.73	2.47	5.5	1.53	0	0	0	0	0	0
	tha	Thamnoclonium dichotomum	0	0	0	0	0	0	9.87	3.9	14.7	3.77	0.1	0.1	0	0	0	0
Total algae			85.2		90		74		41.3		20.2		0.1		0		0	
Cnidarians	brc	Stoloniferous octocoral (bramble coral)	0	0	0	0	0	0	0	0	0	0	0	0	3	1.39	0	0
	sco	Solitary coral	0	0	0	0	0	0	0.13	0.13	0	0	0	0	0	0	0.6	0.97
	sea	Seapen	0	0	0	0	0	0	0	0	0	0	5.3	1.03	0	0	0	0
	soc	Soft coral	0	0	0	0	0	0	1.33	0.99	0.3	0.22	0	0	0	0	0	0
	whi	Seawhips	0	0	0	0	0	0	0	0	0.3	0.3	0	0	0	0	0	0
	yez	Yellow zooanthid	0	0	0	0	0	0	0	0	0	0	0	0	1.3	0.75	0.4	1.26
Total cnidarians			0		0		0		1.47		0.6		5.3		4.3		1	
Sponges	cus	Cup sponge	0	0	0	0	0	0	0	0	2.3	0.94	0	0	1.2	0.66	1.6	3.24
	cus2	Cup sponge. Spiral form.	0	0	0	0	0	0	0	0	1.2	1.2	0	0	0	0	0	0
	fso	Finger sponge-orange	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0.29	0	0
	sp18	Sponge grey massive	0	0	0	0	0	0	0	0	0.3	0.22	0	0	0	0	0	0
	sp21	Sponge pink-orange knobby	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	1.26
	sp7	Sponge knobby	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0	0
	sp9	Yellow vase sponge	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.2	0.63
	spo	Sponge u/i usually flat	0	0	0	0	0.75	0.53	10.9	2.62	7.4	1.29	0	0	7.8	3.83	1.2	1.69
Total sponges			0		0		0.75		10.9		11.4		0		9.4		3.4	
Bryozoans	br2	Lace bryozoan 2	0	0	0	0	0	0	0	0	0	0	0.6	0.6	2.6	0.96	0.4	1.26
	br5	Branching bryozoan 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.8	1.4
	br6	Branching bryozoan 2	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0.27	0	0
	brs	Bryozoan soft.	0	0	0	0	0.75	0.75	0.13	0.13	0	0	0	0	0	0	0	0
	bry	Lace bryozoan, unidentified	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0
Total bryozoans			0		0		0.75		0.13		0		0.7		3		1.2	
Ascidians	asc	Ascidian u/I	0	0	0	0	0	0	0	0	0.5	0.5	0	0	0	0	0	0
	rta	Red-throated ascidian	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0
	wta	White throated ascidian	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.63
Echinoderms	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0.9	0.46	0.4	1.26
	tom	*Tosia magnifica*	0	0	0	0	0	0	0	0	0.4	0.31	0	0	0.1	0.1	0	0
Cover	epi	Fine hydroid/bryozoan layer	0	0	0	0	0	0	0	0	59.5	5.23	0	0	30.8	6.76	37.2	36.6
	uic	Unidentified cover	0	0	0	0	0	0	26.8	8.32	0	0	0	0	0	0	0	0
Substrate	bre	Bare reef	14.8	7.53	10	3.49	20	6.16	19.2	7.73	63.1	4.21	0	0	37.2	6.69	44.8	37.7
	san	Sand	0	0	0	0	0	0	0	0	3.5	1.29	0	0	0	0	0	0
	sed	Sediment, usually fine	0	0	0	0	0	0	0	0	0.2	0.2	92.9	1.49	45	7.66	49	44.8
Total substrate			14.8		10		20		19.2		66.8		92.9		82.2		93.8	

Table 5. Quantitative estimates of cover vs depth at Sarah Island Transect 2

		Depth (replicates)	0m (1)		1m (4)		2m (2)		5m (20)		10m (17)		15m (22)		20m (18)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	car	*Carpoglossum confluens*	0	0	0	0	30	20	0	0	0	0	0	0	0	0
	dur	*Durvillea potatorum*	100	0	100	0	22	13	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	0	0	27	21	0	0	0	0	0	0	0	0
	les	*Lessonia corrugata*	0	0	0	0	2.5	2.5	0	0	0	0	0	0	0	0
Algae-red	enc	Encrusting corralines	0	0	0	0	16	13	11.2	2.98	0	0	0	0	0	0
	son	*Sonderopelta coriaceae*	0	0	0	0	0	0	0.3	0.22	0	0	0	0	0	0
	tha	*Thamnoclonium dichotomum*	0	0	0	0	0	0	33.3	4.79	0.47	0.36	0.36	0.36	0	0
Total algae			0		100		97		44.8		0.47		0.36		0	
Cnidarians	brc	Stoloniferous octocoral (bramble coral)	0	0	0	0	0	0	0	0	0.47	0.32	0.09	0.09	1.89	1.15
	mo1	Mopsella like -pink hydroids?	0	0	0	0	0	0	0	0	0	0	2.27	0.97	0.56	0.56
	soc	Soft coral	0	0	0	0	0	0	0.1	0.1	0	0	0.09	0.09	0	0
	whi	Seawhips	0	0	0	0	0	0	0.1	0.1	0	0	0.27	0.19	0	0
	yez	Yellow zooanthid	0	0	0	0	0	0	0	0	1.88	1.24	4.09	2.35	1.44	0.9
	hyd	Hydroids	0	0	0	0	0	0	0	0	0	0	2.09	2.04	0	0
Total cnidarians			0		0		0		0.2		2.35		8.91		3.89	
Sponges	cus	Cup sponge	0	0	0	0	0	0	2.1	1.03	0.24	0.24	3.55	1.86	5.89	1.19
	cus2	Cup sponge. Spiral form.	0	0	0	0	0	0	0.2	0.2	0.47	0.47	0	0	0	0
	fsfw	Finger sponge fine white,*Thamnoclonium*?	0	0	0	0	0	0	0	0	0	0	0.45	0.44	0	0
	fso	Finger sponge-orange	0	0	0	0	0	0	0.1	0.1	0.71	0.59	0.36	0.28	0	0
	gbs	Golfball sponge	0	0	0	0	0	0	0	0	0	0	0.09	0.09	0	0
	sp13	Finger sponge, slender white	0	0	0	0	0	0	0	0	2.94	1.54	0.09	0.09	2.11	0.71
	sp14	Vase sponge	0	0	0	0	0	0	0	0	0	0	0.09	0.09	0.11	0.11
	sp15	Volcano sponge	0	0	0	0	0	0	0	0	0	0	0.18	0.18	0	0
	sp16	Sponge small white ascidian like	0	0	0	0	0	0	0	0	0	0	0.45	0.44	0	0
	sp17	Sponge massive white-grey	0	0	0	0	0	0	0	0	0	0	0	0	0.67	0.67
	sp18	Sponge grey massive	0	0	0	0	0	0	0.5	0.41	0	0	0	0	0	0
	spo	Sponge u/i usually flat	0	0	0	0	1.6	1.6	9	1.37	8.82	4.49	6.64	1.71	7.67	1.38
	spo2	Sponge u/i usually flat	0	0	0	0	0	0	0.5	0.5	0	0	0	0	0	0
Total sponges			0		0		1.6		12.4		13.2		11.9		16.4	
Bryozoans	brf	Lace bryozoan 5	0	0	0	0	0	0	0	0	0	0	0.09	0.09	0.11	0.11
	bry	Lace bryozoan, unidentified	0	0	0	0	0	0	0.2	0.14	0	0	0	0	0	0
Total bryozoans			0		0		0		0.2		0		0.09		0.11	
Ascidians	as6	Colonial ascidian 3, scallop shape	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0	0
	rta	Red-throated ascidian	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0	0
	wta	White throated ascidian	0	0	0	0	0	0	0	0	0	0	0	0	0.22	0.22
Molluscs	hal	*Haliotis rubra*	0	0	0	0	0	0	0.1	0.1	0	0	0	0	0	0
Echinoderms	bas	Basketstar	0	0	0	0	0	0	0	0	0.12	0.12	0	0	0	0
	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0	0	0.47	0.21	0.27	0.15	0	0
	pet	*Petricia vernicina*	0	0	0	0	0	0	0.1	0.1	0	0	0	0	0	0
	tom	*Tosia magnifica*	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0.11
Other Cover	epi	Fine hydroid/bryozoan layer	0	0	0	0	0	0	41.8	3.77	47.3	11.2	48.4	7.15	61.6	7.34
Substrate	bre	Bare reef	0	0	0	0	1.6	1.6	41.8	3.77	81.1	6.03	58.5	6.17	75.9	3.42
	san	Sand	0	0	0	0	0	0	0	0	6.12	4.72	7	3.19	3.22	1.28
	sed	Sediment, usually fine	0	0	0	0	0	0	0	0	4.94	4.94	0	0	0	0
	sgr	Sand/gravel	0	0	0	0	0	0	0	0	5.18	5.18	13	6.99	0	0
Total substrate			0		0		1.6		41.8		97.3		78.5		79.1	

Table 6. Quantitative estimates of cover vs depth at Sarah Island Transect 3

		Depth (replicates)	1m (3)		2m (5)		5m (15)		10m (21)		15m (25)		20m (22)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	car	*Carpoglossum confluens*	0	0	76.4	11.2	0	0	0	0	0	0	0	0
	cos	*Codium spp.*	0	0	0	0	2.13	1.51	0	0	0	0	0	0
	dur	*Durvillea potatorum*	100	0	0	0	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	10.8	9.83	0	0	0	0	0	0	0	0
	xip	*Xiphophora gladiata*	0	0	14	14	0	0	0	0	0	0	0	0
Algae-red	tha	*Thamnoclonium dichotomum*	0	0	2	2	3.2	2.93	0	0	0	0	0	0
	tre	Thallose red algae	0	0	0	0	0.27	0.27	0	0	0	0	0	0
	gco	Genniculate corraline algae	0	0	0	0	0.4	0.29	0	0	0	0	0	0
Total algae			100		103		5.6		0		0		0	
Cnidarians	brc	Stoloniferous octocoral (bramble coral)	0	0	0	0	0	0	0	0	2.48	1.27	0	0
	brc2	Stoloniferous octocoral 2 (bramble coral)	0	0	0	0	0	0	0	0	0.24	0.24	0	0
	mop	Isidid sp. triangle shape	0	0	0	0	0	0	0	0	0.24	0.24	0	0
	sco	Solitary coral	0	0	0	0	0	0	0.1	0.1	0.08	0.08	0.36	0.21
	soc	Soft coral	0	0	0	0	0.4	0.4	0.6	0.4	0	0	0	0
	whi	Seawhips	0	0	0	0	0	0	0.2	0.13	0	0	0	0
	yez	Yellow zooanthid	0	0	0	0	0	0	0	0	1.52	1.1	0.45	0.36
Total cnidarians			0		0		0.4		0.9		4.56		0.82	
Sponges	cus	Cup sponge	0	0	0	0	0	0	0	0	2.24	0.77	0	0
	sp10	sponge, pink broad, branching	0	0	0	0	0	0	0	0	0.56	0.32	0	0
	sp3	Finger sponge 3, fine white/grey	0	0	0	0	0	0	0.5	0.49	4.48	1.4	0	0
	sp7	Sponge knobby	0	0	0	0	0	0	0	0	0.64	0.64	2.18	2.13
	sp8	Grey sponge, club like projections.	0	0	0	0	0	0	0	0	1.6	0.7	0	0
	sp9	Yellow vase sponge	0	0	0	0	0	0	0	0	0.16	0.16	0	0
	spo	Sponge u/i usually flat	0	0	0	0	0.93	0.47	1.2	0.41	5.36	1.02	6.18	1.54
Total sponges			0		0		1.33		1.7		15		8.36	
Bryozoans	br1	Lace bryozoan 1	0	0	0	0	0	0	0	0	0.56	0.56	0	0
	br2	Lace bryozoan 2	0	0	0	0	0	0	0	0	0.16	0.16	0	0
	br5	Branching bryozoan 1	0	0	0	0	0	0	0	0	0.32	0.22	0	0
Total bryozoans			0		0		0		0		1.04		0	
Ascidians	as1	Ascidian solitary 1	0	0	0	0	0.13	0.13	0	0	0	0	0	0
	as2	Ascidian colonial stalked.	0	0	0	0	0	0	0.2	0.13	0	0	0	0
	as3	Colonial ascidian 1	0	0	0	0	0	0	0.2	0.2	0	0	0.09	0.09
	as4	Colonial ascidian 9, blue golfball.	0	0	0	0	0	0	0	0	0.08	0.08	0	0
	wta	White throated ascidian	0	0	0	0	0	0	0.2	0.13	0	0	0	0
Echinoderms	gon	*Goniocidaris tubaria*	0	0	0	0	0.27	0.27	0	0	0.08	0.08	0.82	0.56
	tom	*Tosia magnifica*	0	0	0	0	0.4	0.4	0	0	0	0	0	0
Other Cover	breb	Fine hydroid/bryozoan layer	0	0	0	0	0	0	0	0	26.1	7.39	4.09	4
Substrate	bre	Bare reef	0	0	2.4	1.6	9.47	6.83	4.2	4.1	49.7	8.54	81.7	6
	gra	Gravel	0	0	0	0	14	9.04	0	0	0	0	0	0
	san	Sand	0	0	0	0	0	0	12.6	7.78	0	0	0	0
	sed	Sediment, usually fine	0	0	0	0	0	0	0	0	0	0	4.55	4.45
	sgr	Sand/gravel	0	0	0	0	63.2	12	80.0	10.4	0	0	0	0
Total substrate			0		2.4		86.7		96.8		49.7		86.3	

Table 7. Quantitative estimates of cover vs depth at Waterfall Bay Transect 1

		Depth (replicates)	1m (1)		2m (4)		5m (20)		5m reef (21)		6m (7)		7m (20)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae	alg	*Unidentified algae*	18	0	0	0	0	0	0	0	0	0	0	0
Algae-brown	car	*Carpoglossum confluens*	0	0	21	8.1	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	6.5	4.27	0	0	0	0	0	0	0	0
	mac	*Macrocystis pyrifera*	2	0	5	5	0	0	0	0	0	0	0	0
	tbr	Turfing brown algae	0	0	22.5	16.5	0	0	0	0	0	0	0	0
	xip	*Xiphophora gladiata*	48	0	3	3	0	0	0	0	0	0	0	0
Algae-green	csoc	*Codium* spp.	0	0	0	0	0	0	0.2	0.2	0	0	0	0
	ulv	*Ulva* spp.	32	0	0	0	0	0	0	0	0	0	0	0
Algae-red	enc	Encrusting corralines	0	0	0	0	0	0	4.4	2.12	0	0	0	0
	tha	*Thamnoclonium dichotomum*	0	0	0	0	1	0.75	10.2	3.31	0	0	0	0
Total algae			100		58		1		14.8		0		0	
Cnidarians	oct	Common octocoral	0	0	0	0	0	0	2	1.39	0	0	0	0
	sea	Seapen	0	0	0	0	0	0	0	0	0	0	0	0
	soc	Soft coral	0	0	0	0	7.1	1.49	4.9	2.23	2.86	1.94	0	0
Total cnidarians			0		0		7.1		6.9		2.86		0	
Sponges	cus	Cup sponge	0	0	0	0	1.1	0.73	0	0	0	0	0	0
	fsfw	Finger sponge fine white,*Tham?*	0	0	0	0	0	0	0.4	0.27	0	0	0	0
	spo	Sponge u/i usually flat	0	0	2	2	0.7	0.26	8.5	1.93	0	0	0	0
Total sponges			0		2		1.8		8.9		0		0	
Bryozoans	br5	Branching bryozoan 1	0	0	0	0	0	0	0.2	0.2	0	0	0	0
	brf	Lace bryozoan 5	0	0	0	0	0	0	0.5	0.49	0	0	0	0
	bry	Lace bryozoan, unidentified	0	0	0	0	0	0	0.3	0.21	0	0	0	0
Total bryozoans			0		0		0		1		0		0	
Ascidians	as10	Ascidian colonial stalked	0	0	0	0	0	0	0	0	0	0	0.1	0.1
	as7	Colonial ascidian 4 shiny white	0	0	0	0	0.2	0.2	0	0	0	0	0	0
	as8	Colonial ascidian 5	0	0	0	0	0	0	0.3	0.29	0	0	0	0
	as9	Colonial ascidian 6	0	0	0	0	0	0	0.1	0.1	0	0	0	0
	asc	Ascidian u/I	0	0	0	0	0.1	0.1	0	0	0	0	0	0
	rta	Red-throated ascidian	0	0	0	0	0.7	0.42	0	0	0	0	0	0
Echinoderms	ber	Basketstar	0	0	0	0	0	0	3.6	3.51	0	0	0	0
	tom	*Tosia magnifica*	0	0	0	0	0	0	0	0	0	0	0.2	0.2
Other Cover	breb	Fine hydroid/bryozoan layer	0	0	40	15.4	0	0	71.9	5.63	0	0	0	0
Substrate	bre	Bare reef	0	0	40	15.4	19.2	8.82	68.3	6.63	0	0	0	0
	san	Sand	0	0	0	0	28.4	12.3	1.5	1.46	0	0	0	0
	sed	Sediment, usually fine	0	0	0	0	4.4	4.4	0	0	97.1	1.94	99.9	0.1
	sgr	Sand/gravel	0	0	0	0	21.7	8.67	0	0	0	0	0	0
	ssh	Sand with shells	0	0	0	0	20.4	8.11	0	0	0	0	0	0
Total cover			0		40		94.1		69.8		97.1		99.9	

Table 8. Quantitative estimates of cover vs depth at Waterfall Bay Transect 2

		Depth (replicates)	0m (5)		0.5m (5)		1m (6)		2m (15)		5m (26)		7m (25	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	bro	Brown algae unidentified	2	2	0	0	0	0	0	0	0	0	0	0
	1 car	*Carpoglossum confluens*	0	0	52.8	8.4	27	16.3	21.6	7.46	0	0	0	0
	1 cau	*Caulocystis* sp.	0	0	6.4	5.04	0	0	0	0	0	0	0	0
	1 eck	*Ecklonia radiata*	0	0	0	0	19.7	10.4	34.8	9.16	0	0	0	0
	1 fbr	Fillamentous browns	0	0	1.2	1.2	0	0	0	0	0	0	0	0
	1 halo	*Halopteris panniculata*	0	0	0	0	0	0	5.74	5.74	0	0	0	0
	1 hor	*Hormisira banksii*	20.4	13	0	0	0	0	0	0	0	0	0	0
	1 mac	*Macrocystis pyrifera*	0	0	1.2	1.2	17.3	16.5	0.26	0.26	0	0	0	0
	1 scy	*Scytosiphon lomentaria*	2.8	2.8	0	0	0	0	0	0	0	0	0	0
	1 xip	*Xiphophora gladiata*	0	0	27.6	11.5	3	3	0	0	0	0	0	0
Algae-green	cop	*Codium pomoides*	0	0	0	0	0	0	0.66	0.66	0	0	0	0
	2 ulv	*Ulva* spp.	29.2	10.2	1.6	1.6	0	0	0	0	0	0	0	0
Algae-red	bal	*Ballia callitrichia*	0	0	0	0	0	0	1.34	1.34	0	0	0	0
	3 enc	Encrusting corralines	1.6	1.6	0	0	0	0	4.94	1.72	0	0	0	0
	3 rho	*Rhodymenia* spp.	0	0	0	0	0	0	0.66	0.66	0	0	0	0
	3 tre	Thallose red algae	0	0	0	0	0	0	1.2	1.2	0	0	0	0
Total algae			56		90.8		67		71.2		0		0	
Cnidarians	sea	Seapen	0	0	0	0	0	0	0	0	0.84	0.44	0.72	0.42
	soc	Soft coral	0	0	0	0	0	0	0	0	2.62	1.78	0	0
Total cnidarians			0		0		0		0		3.46		0.72	
Sponges	spo	Sponge u/i usually flat	0	0	0	0	0	0	0	0	0.08	0.08	0	0
Ascidians	yta	Yellow-throated ascidian	0	0	0	0	0	0	0	0	0.16	0.16	0	0
Substrate	sed	Sediment, usually fine	0	0	0	0	0	0	0	0	96.4	1.78	99.2	0.42
	bre	Bare reef	44	15.1	9.2	3.82	33	13	22.2	4.98	0	0	0	0
Total substrate			44		9.2		33		22.2		96.4		99.2	

Table 9. Quantitative estimates of cover vs depth at Waterfall Bay Transect 2 extension

		Depth (replicates)	7m (13)		8m (7)		9m (8)		10m (6)		11m (6)		12m (6)		13m (7)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Cnidarians	sea	Seapens	0.77	0.48	2	1.15	1.75	0.8	1	0.68	0	0	0.67	0.67	0	0
Substrate	sed	Sediment	99.2	0.48	98	1.15	98.3	0.8	99	0.68	100	0	99.3	0.67	100	0

Table 10. Quantitative estimates of cover vs depth at Beabey Point Transect 1

Site	Code	Description of species or cover	0m (5) mean	se	0.5m (7) mean	se	1m (6) mean	se	2m (15) mean	se	5m (21) mean	se	10m (13) mean	se	15m (16) mean	se	17m (1) mean	se
Algae	alg	Unidentified algae	0	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0
Algae-brown	car	*Carpoglossum confluens*	0	0	42.3	16.7	12.3	8.27	7.2	3.79	0	0	0	0	0	0	0	0
	cys	*Cystophora* sp.	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	3.71	3.71	84.7	7.26	30.9	9.58	0	0	0	0	0	0	0	0
	enc	Encrusting corralines	0	0	0	0	2	2	14.9	5.21	4	1.88	0	0	0	0	0	0
	hor	*Hormisira banksii*	34.8	14.6	2.94	2.12	0	0	0	0	0	0	0	0	0	0	0	0
	mac	*Macrocystis pyrifera*	0	0	26.9	16.3	0	0	17.2	8.5	0	0	0	0	0	0	0	0
	scy	*Scytosiphon lomentaria*	6.8	6.8	0.97	0.97	0	0	0	0	0	0	0	0	0	0	0	0
	xip	*Xiphophora gladiata*	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0
Algae-green	ulv	*Ulva* spp.	56.8	12.8	2.68	1.88	0	0	0	0	0	0	0	0	0	0	0	0
	rho	*Rhodymenia* spp.	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0	0	0
	son	*Sonderopelta coriaceae*	0	0	0	0	0	0	0	0	2.5	1.68	0	0	0	0	0	0
	tha	*Thamnoclonium dichotomum*	0	0	0	0	0	0	0.8	0.8	21.3	5.34	0	0	0	0	0	0
Total algae	tota		98.4		91.4		101		71.1		28		0		0		0	
Cnidarians	oct	Common octocoral	0	0	0	0	0	0	0	0	0	0	0	0	0.38	0.38	0	0
	soc	Soft coral	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0	0	0
	whi	Seawhips	0	0	0	0	0	0	0	0	0.3	0.21	0	0	0	0	0	0
Total cnidarians	totc		0		0		0		0		0.4		0		0.38		0	
Sponges	cus	Cup sponge	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0.5	0.5	0	0
	spo	Sponge u/i usually flat	0	0	0	0	0	0	0	0	2.7	0.89	0.77	0.36	2.25	0.89	6	0
Total sponges	tots		0		0		0		0		2.8		0.77		2.75		6	
Bryozoans	bry	Lace bryozoan, unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0.13	0	0
Total bryozoans	totb		0		0		0		0		0		0		0.13		0	
Ascidians	asc	Ascidian u/I	0	0	0	0	0	0	0	0	0	0	0	0	0.38	0.38	0	0
	yta	Yellow-throated ascidian	0	0	0	0	0	0	0	0	0	0	0.15	0.15	0.13	0.13	0	0
Echinoderms	ber	Basketstar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
	tom	*Tosia magnifica*	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0.25	0.17	0	0
Other Cover	breb	Fine hydroid/bryozoan layer	0	0	0	0	0	0	27.1	8.37	25.7	6.89	0	0	7.88	6.17	4	0
	uid	Unidentified cover	1.6	1.6	0.23	0.23	0	0	0	0	0	0	0	0	0	0	0	0
Substrate	bre	Bare reef	0	0	0	0	3	1.44	27.6	8.27	26.3	6.8	0	0	7.63	5.93	0	0
	gra	Gravel	0	0	0	0	0	0	0	0	5	4.88	0	0	0	0	0	0
	grs	Gravel with shells	0	0	0	0	0	0	0	0	0	0	0	0	12.5	8.54	0	0
	san	Sand	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0.25	0	0
	sed	Sediment, usually fine	0	0	0	0	0	0	1.33	1.33	25.9	7.35	99.1	0.37	12.6	8.53	90	0
	sgr	Sand/gravel	0	0	0	0	0	0	0	0	15	7.99	0	0	58.8	12	0	0
Total substrate	totsub		0		0		3		28.9		72.2		99.1		91.8		90	

Table 11. Quantitative estimates of cover vs depth at Forrester Point Transect 1

		Depth (replicates)	1m (5)		2m 96)		5m (15)		10m (16)		15m (16)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	car	*Carpoglossum confluens*	16	10.3	10.4	6.77	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	39.2	16	0	0	0	0	0	0
	hor	*Hormisira banksii*	4.4	3.12	0	0	0	0	0	0	0	0
Algae-green	ulv	*Ulva* spp.	78.8	11.4	0	0	0	0	0	0	0	0
Algae-red	enc	Encrusting corralines	0	0	0	0	3.2	2.18	0	0	0	0
	tha	Thamnoclonium dichotomum	0	0	0	0	8.27	3.78	0	0	0	0
Total algae			99.2		49.6		11.5		0		0	
Cnidarians	oct	Common octocoral	0	0	0	0	6.93	2.87	0.75	0.75	3.13	1.66
	brc	Stoloniferous octocoral (bramble coral)	0	0	0	0	0	0	0.25	0.25	0	0
	whi	Seawhips	0	0	0	0	12	2.75	5.63	1.66	0	0
	yez	Yellow zooanthid	0	0	0	0	0	0	0	0	0.5	0.39
Total cnidarians			0		0		18.9		6.63		3.63	
Sponges	cus	Cup sponge	0	0	0	0	0	0	0.25	0.25	5.38	1.75
	fso	Finger sponge-orange	0	0	0	0	0	0	0	0	0.38	0.38
	fsw	Fnger sponge-white,cf orange	0	0	0	0	0	0	0	0	0.38	0.38
	sp11	Large grey sponge, spines	0	0	0	0	0	0	1.63	1.63	0	0
	sp2	Sponge finger, very fine white/grey	0	0	0	0	0.93	0.93	0.25	0.25	0	0
	spo	Sponge u/i usually flat	0	0	0	0	6.67	1.13	2	0.89	4.5	1.06
Total sponges			0		0		7.6		4.13		10.6	
Bryozoans	brf	Lace bryozoan 5	0	0	0	0	0	0	0.5	0.5	0.13	0.13
	bry	Lace bryozoan, unidentified	0	0	0	0	0	0	0.5	0.34	0.63	0.51
Total bryozoans			0		0		0		1		0.75	
Ascidians	as2	Ascidian colonial stalked.	0	0	0	0	0	0	0.25	0.25	0	0
	as5	colonial ascidian 2	0	0	0	0	0	0	1.25	0.7	0	0
	wta	White throated ascidian	0	0	0	0	0.13	0.13	0	0	0	0
Molluscs	myt	*Mytilus edulis*	0.4	0.4	0	0	0	0	0	0	0	0
Echinoderms	bas	Basketstar	0	0	0	0	0	0	0.75	0.4	0	0
	gon	*Goniocidaris tubaria*	0	0	0	0	0.27	0.18	0	0	0	0
	tom	*Tosia magnifica*	0	0	0	0	0	0	0.13	0.13	0	0
Other Cover	breb	Fine hydroid/bryozoan layer	0	0	47.6	19.4	58.4	5.76	50.5	9.3	76.8	4.87
	uid	Unidentified cover	0	0	0	0	0	0	0	0	0.38	0.38
Substrate	bre	Bare reef	0	0	47.6	19.4	59.6	5.5	65.9	7.28	77	5.74
	san	Sand	0	0	0	0	0	0	10	5.65	0.63	0.63
	sed	Sediment, usually fine	0	0	0	0	3.33	3.33	10.5	5.58	6	3.29
	sgr	Sand/gravel	0	0	0	0	0.53	0.53	0	0	0	0
Total substrate			0		47.6		63.5		86.4		83.6	

Table 12. Quantitative estimates of cover vs depth at Forrester Point Transect 2

		Depth (replicates)	2m (15)		5m (12)		10m (21)		15m (19)		20m (19)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	eck	*Ecklonia radiata*	30.7	9.38	0	0	0	0	0	0	0	0
Algae-red	enc	Encrusting corralines	0.53	0.53	1	0.83	0	0	0	0	0	0
	tha	*Thamnoclonium dichotomum*	1.07	1.07	0.33	0.33	0	0	0	0	0	0
Total algae			32.3		1.33		0		0		0	
Cnidarians	oct	Common octocoral	0	0	3.5	2.36	9.8	2.36	1.37	0.68	1.11	0.88
	soc	Soft coral	0.27	0.27	0	0	0	0	0	0	0	0
	whi	Seawhips	0	0	28	9.29	1.6	0.59	0	0	0.22	0.15
	yez	Yellow zooanthid	0	0	0	0	0.4	0.23	0.95	0.56	0.56	0.26
Total cnidarians			0.27		31.5		11.8		2.32		1.89	
Sponges	cus	Cup sponge	0	0	0	0	2.4	0.92	5.89	1.48	8.89	2.5
	fsfw	Finger sponge fine white,*Thamnoclonium*?	0	0	0	0	0	0	0.53	0.53	0.33	0.32
	fsk	Finger sponge knobby	0	0	0	0	0	0	0	0	0.22	0.22
	fso	Finger sponge-orange	0	0	0	0	0	0	0.53	0.53	1.33	0.72
	fsu	Finger sponge fine brown	0	0	0	0	0.2	0.2	0.32	0.32	0	0
	jhs	Jokers hat sponge	0	0	0	0	0.1	0.1	0	0	0	0
	spf	sponge, flattened, broad, branched, pink	0	0	0	0	0	0	0	0	0.33	0.32
	spo	Sponge u/i usually flat	0	0	9	2.15	12	2.53	5.26	1.21	6.78	1.5
Total sponges			0	0	9	2.15	14.7	3.75	12.5	4.05	17.9	5.59
Bryozoans	br5	Branching bryozoan 1	0	0	0	0	0	0	0	0	0.33	0.32
	brf	Lace bryozoan 5	0	0	0	0	0.6	0.59	1.26	0.72	2.11	1.45
	brg	Lace Bryozoan 6	0	0	0	0	0.1	0.1	0.42	0.25	0.22	0.22
	bry	Lace bryozoan, unidentified	0	0	0	0	0.1	0.1	0.11	0.11	0	0
Total bryozoans			0		0		0.8		1.79		2.67	
Ascidians	as6	Colonial ascidian 3, scallop shape	0	0	0	0	0.3	0.29	0.11	0.11	0	0
	wta	White throated ascidian	0	0	0	0	0.1	0.1	0	0	0	0
Echinoderms	bas	Basketstar	0	0	0	0	0.2	0.13	0	0	0	0
	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0	0	0.11	0.11
	tom	*Tosia magnifica*	0	0	0	0	0	0	0.11	0.11	0.11	0.11
Other Cover	breb	Fine hydroid/bryozoan layer	0	0	65.3	7.06	59.5	5.32	47.9	10.3	50.9	6.83
	uid	Unidentified cover	2.67	2.67	1	1	0	0	0	0	3.78	2.53
Substrate	bre	Bare reef	64.8	9.93	58.3	8.03	61.5	4.99	74.1	4.55	53.6	5.9
	san	Sand	0	0	0	0	4.8	3.15	4.11	4.11	0.22	0.22
	sed	Sediment, usually fine	0	0	0	0	0.4	0.39	4.84	3.6	20.2	6.35
Total substrate			64.8		58.3		66.7		83.1		74	

Table 13. Quantitative estimates of cover vs depth at Forrester Point Transect 3

		Depth (replicates)	0.5m (10)		1m (10)		2m (19)		5m (15)		10m (11)		15m (12)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae	alg	Unidentified algae	4	4	0	0	0	0	0	0	0	0	0	0
Algae-brown	car	*Carpoglossum confluens*	9.2	9.2	18.8	11.9	1.75	1.61	0	0	0	0	0	0
	eck	*Ecklonia radiata*	2.8	2.8	38.8	16.8	32.3	8.7	0	0	0	0	0	0
	hor	*Hormisira banksii*	36.8	14.9	0	0	0	0	0	0	0	0	0	0
Algae-green	ulv	*Ulva* spp.	16	4.52	0	0	0	0	0	0	0	0	0	0
Algae-red	enc	Encrusting corralines	0	0	0	0	0.63	0.4	1.07	0.13	0	0	0	0
	red	Red rock. *Peysionell*a spp?	0	0	0	0	0.38	0.34	0	0	0	0	0	0
	tha	*Thamnoclonium dichotomum*	0	0	0	0	4.5	2.17	2.4	0.29	0	0	0	0
	tre	Thallose red algae	6	2.45	0	0	0	0	0	0	0	0	0	0
Total algae			74.8		57.6		39.5		3.47		0		0	
Cnidarians	oct	Common octocoral	0	0	0	0	0	0	0.67	0.12	0.18	0.05	0	0
	an2	Common tube anemone	0	0	0	0	0	0	0	0	0	0	0.67	0.67
	whi	Seawhips	0	0	0	0	0	0	0.4	0.1	0	0	0	0
Total cnidarians			0		0		0		1.07		0.18		0.67	
Sponges	fso	Finger sponge-orange	0	0	0	0	0	0	0.53	0.11	1.45	0.38	0	0
	spo	Sponge u/i usually flat	0	0	0	0	0.25	0.23	1.6	0.17	0.55	0.08	0	0
Total sponges			0		0		0.25		2.13		2		0	
Ascidians	wta	White throated ascidian	0	0	0	0	0	0	0	0	0	0	0.17	0.17
Molluscs	myt	*Mytilus edulis*	1.2	1.2	0	0	0	0	0	0	0	0	0	0
Echinoderms	pat	*Patiriella brevispinna*	0	0	0	0	0	0	0.13	0.03	0	0	0	0
Other Cover	breb	Fine hydroid/bryozoan layer	0	0	0	0	42.4	9.01	31.2	1.5	10.5	2.1	0	0
Substrate	bre	Bare reef	23.6	5.64	42.4	12.9	55.9	7.7	31.2	1.5	10.5	2.1	0	0
	cob	Cobble	0	0	0	0	0	0	0	0	36.2	4.56	0	0
	gra	Gravel	0	0	0	0	1	0.92	0	0	14	2.91	0	0
	grs	Gravel with shells	0	0	0	0	0	0	0	0	37.1	4.28	0	0
	san	Sand	0	0	0	0	3	1.6	2.27	0.59	0	0	0	0
	sed	Sediment, usually fine	0	0	0	0	0	0	0	0	0	0	99.2	0.67
	sgr	Sand/gravel	0	0	0	0	0.38	0.34	54.3	2.21	0	0	0	0
Total substrate			23.6		42.4		60.3		87.7		97.8		99.2	

Table 14. Quantitative estimates of cover vs depth at Munday Island Transect 1

		Depth (replicates)	0m (4)		1m (4)		5m (15)		10m (20)		20m (19)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	car	*Carpoglossum confluens*	0	0	17.5	11.1	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	79.5	14	0	0	0	0	0	0
	hor	*Hormisira banksii*	47.5	6.29	0	0	0	0	0	0	0	0
Algae-green	cha	*Chaetomorpha billardierii*	1	1	0	0	0	0	0	0	0	0
	cos	*Codium* spp.	0	0	0	0	0.8	0.8	0	0	0	0
	fgr	Fillamentous greens	4.5	4.5	0	0	0	0	0	0	0	0
	ulv	*Ulva* spp.	42.5	14.9	0	0	0	0	0	0	0	0
Algae-red	enc	Encrusting corralines	0	0	3	3	2.8	2.13	0	0	0	0
	fre	Fillamentous reds	4.5	4.5	0	0	0	0	0	0	0	0
	tha	*Thamnoclonium dichotomum*	0	0	0	0	6.8	2.44	0	0	0	0
Total algae			100		100		10.4		0		0	
Cnidarians	oct	Common octocoral	0	0	0	0	0.4	0.4	0.8	0.8	0.22	0.22
	soc	Soft coral	0	0	0	0	0.13	0.13	0	0	0	0
	whi	Seawhips	0	0	0	0	27.5	4.12	1.3	0.51	0	0
	yez	Yellow zooanthid	0	0	0	0	0	0	0	0	0.33	0.32
Total cnidarians			0		0		28		2.1		0.56	
Sponges	cus	Cup sponge	0	0	0	0	0	0	0.2	0.2	0	0
	cus2	Cup sponge. Spiral form.	0	0	0	0	0	0	0.1	0.1	0	0
	fso	Finger sponge-orange	0	0	0	0	1.07	0.61	0	0	0	0
	sp10	sponge, pink broad, branching	0	0	0	0	0	0	0	0	0.22	0.22
	sp3	Finger sponge 3, fine white/grey	0	0	0	0	0.13	0.13	0	0	0.22	0.22
	spo	Sponge u/i usually flat	0	0	0	0	9.87	1.37	8.6	2.11	15.3	2.42
Total sponges			0		0		11.1		8.9		15.8	
Bryozoans	br1	Lace bryozoan 1	0	0	0	0	0	0	0.2	0.2	0	0
	brf	Lace bryozoan 5	0	0	0	0	0	0	1.2	0.93	0	0
	brg	Lace Bryozoan 6	0	0	0	0	0	0	0.2	0.2	0	0
	bry	Lace bryozoan, unidentified	0	0	0	0	0	0	0.2	0.2	0	0
Total bryozoans			0		0		0		1.8		0	
Ascidians	as1	Ascidian solitary 1	0	0	0	0	0	0	0.4	0.4	0	0
	as4	Colonial ascidian 9, blue golfball.	0	0	0	0	0	0	0.1	0.1	0	0
	wta	White throated ascidian	0	0	0	0	0.13	0.13	0.1	0.1	0	0
Echinoderms	bas	Basketstar	0	0	0	0	0.27	0.18	0.1	0.1	0	0
	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0.5	0.29	0.11	0.11
	hel	*Heliocidaris erytrogramma*	0	0	0	0	0.13	0.13	0	0	0	0
	sti	*Stichopus mollis*	0	0	0	0	0.13	0.13	0	0	0	0
	toa	*Tosia australis*	0	0	0	0	0	0	0.1	0.1	0	0
	tom	*Tosia magnifica*	0	0	0	0	0	0	0.1	0.1	0	0
Other Cover	epi	Fine hydroid/bryozoan layer	0	0	0	0	32.9	9.24	40.9	7.13	76.2	2.43
Substrate	bre	Bare reef	0	0	0	0	47.9	4.07	77.8	6.01	79.6	2.33
	gra	Gravel	0	0	0	0	4.67	2.76	0	0	1.22	0.82
	san	Sand	0	0	0	0	0	0	0	0	0.56	0.54
	sgr	Sand/gravel	0	0	0	0	0	0	0	0	2.22	1.48
Total cover			0		0		52.5		77.8		83.6	

Table 15. Quantitative estimates of cover vs depth at Munday Island Transect 2

		Depth (replicates)	0m (6)		0.5m (5)		1m (5)		2m (15)		5m (19)		10m (19)		15m (18)		20m (17)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	bro	Brown algae unidentified	4	4	0	0	0.8	0.8	0	0	0	0	0	0	0	0	0	0
	car	*Carpoglossum confluens*	19.7	16.2	59.6	14.7	8	8	0.93	0.93	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	14.4	6.31	25.6	19.4	5.87	5.32	0	0	0	0	0	0	0	0
	hor	*Hormisira banksii*	2.67	1.23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	zon	*Zonaria* spp.	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae-green	ulv	*Ulva* spp.	47	16	0	0	0	0	0.27	0.27	0	0	0	0	0	0	0	0
Algae-red	enc	Encrusting corralines	0	0	0	0	0	0	22.4	6.45	0	0	0	0	0	0	0	0
	tha	*Thamnoclonium dichotomum*	0	0	0	0	0	0	6	2.12	0.22	0.22	0	0	0	0	0	0
	tre	Thallose red algae	6	3.83	0	0	2	2	0	0	0	0	0	0	0	0	0	0
Total algae			80.3		74		36.4		35.5		0.22		0		0		0	
Cnidarians	oct	Common octocoral	0	0	0	0	0	0	0	0	2.67	0.94	6.89	1.41	3.78	1.6	0.35	0.26
	whi	Seawhips	0	0	0	0	0	0	0	0	5.67	1.64	0.11	0.11	0	0	0	0
	yez	Yellow zooanthid	0	0	0	0	0	0	0	0	0	0	0	0	0.44	0.35	0	0
	hyd	Hydroids	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0
Total cnidarians			0		0		0		0		8.33		7		4.56		0.35	
Sponges	cus	Cup sponge	0	0	0	0	0	0	0	0	0	0	1.78	0.72	0	0	0	0
	sp11	Large grey sponge, spines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.47	0.47
	sp17	Sponge massive white-grey	0	0	0	0	0	0	0	0	0	0	0	0	0.56	0.56	0	0
	sp21	Sponge pink-orange knobby	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0
	sp23	Sponge grey massive	0	0	0	0	0	0	0	0	0	0	0.33	0.32	0	0	0	0
	spo	Sponge u/i usually flat	0	0	0	0	0	0	1.2	0.73	6.11	1.75	2	0.63	3.22	0.61	2.71	0.66
Total sponges			0		0		0		1.2		6.11		4.11		4.11		3.18	
Bryozoans	br2	Lace bryozoan 2	0	0	0	0	0	0	0	0	0	0	0	0	1.11	0.46	0	0
	br5	Branching bryozoan 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.71	0.51
	bry	Lace bryozoan, unidentified	0	0	0	0	0	0	0	0	0.11	0.11	0.22	0.22	0	0	0.24	0.24
Total bryozoans			0		0		0		0		0.11		0.22		1.11		0.94	
Ascidians	wta	White throated ascidian	0	0	0	0	0	0	0	0	0.33	0.24	0.33	0.18	0	0	0	0
Molluscs	myt	*Mytilus edulis*	4	2.58	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinoderms	bas	Basketstar	0	0	0	0	0	0	0	0	0.11	0.11	0	0	0	0	0	0
	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	tom	*Tosia magnifica*	0	0	0	0	0	0	0	0	0.22	0.22	0.22	0.15	0	0	0	0
Other Cover	epi	Fine hydroid/bryozoan layer	0	0	0	0	0	0	47.3	8.62	75.9	4.88	86.3	1.93	90.1	2.5	4.94	3.54
	uid	Unidentified cover	6.33	6.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Substrate	bre	Bare reef	9.33	8.94	26	15.9	63.6	17.3	63.3	6.51	75.9	4.88	86.3	1.93	90.1	2.5	41.4	8.3
	san	Sand	0	0	0	0	0	0	0	0	4.44	2.57	0	0	0	0	0	0
	sed	Sediment, usually fine	0	0	0	0	0	0	0	0	0.89	0.87	1.89	0.88	0	0	54.1	8.64
Total substrate			9.33		26		63.6		63.3		81.2		88.2		90.1		95.5	

Table 16. Quantitative estimates of cover vs depth at Little Woody Island Transect 1

		Depth (replicates)	0m (4)		0.5m (9)		1m (2)		2m (8)		3m (6)		5m (23)		10m (19)		15m (21)		17m (9)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	car	*Carpoglossum confluens*	8	8	52.7	16.7	0	0	6	4.54	0	0	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	0	0	55	45	31.5	10.4	0	0	0	0	0	0	0	0	0	0
	hor	*Hormisira banksii*	39	21.5	26.4	9.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae-green	cop	*Codium pomoides*	0	0	0	0	0	0	0	0	1.33	0.99	0	0	0	0	0	0	0	0
	ulv	*Ulva* spp.	48	17.2	19.8	9.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae-red	fre	Fillamentous reds	0	0	4	2.96	0	0	0	0	8.67	7.19	0	0	0	0	0	0	0	0
Total algae			95		103		55		37.5		10		0		0		0		0	
Cnidarians	an2	Common tube anemone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.44	2.13
	oct	Common octocoral	0	0	0	0	0	0	0	0	0	0	0	0	27.1	4.82	12.1	2.58	0	0
	sco	Solitary coral	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0.11	0.4	0.18	0	0
	soc	Soft coral	0	0	0	0	0	0	0	0	6.67	6.28	29	4.68	0	0	0	0	0	0
Total cnidarians			0		0		0		0		6.67		29		27.2		12.5		4.44	
Sponges	sp3	Finger sponge 3, fine white/grey	0	0	0	0	0	0	0	0	1.33	1.33	2.43	0.69	0	0	0	0	0	0
	sp5	Finger sponge 5 fine brown *Th*?	0	0	0	0	0	0	0	0	2.67	2.67	0	0	0	0	0	0	0	0
	sp6	Tube sponge?	0	0	0	0	0	0	0	0	4.67	4.67	0	0	0	0	0	0	0	0
	spo	Sponge u/i usually flat	0	0	0	0	0	0	0	0	1.33	0.42	12	1.96	2.56	0.44	3.1	0.79	0	0
Total sponges			0		0		0		0		10		14.4		2.56		3.1		0	
Bryozoans	br2	Lace bryozoan 2	0	0	0	0	0	0	0	0	0	0	1.57	1.39	0	0	0	0	0	0
	br3	Lace bryozoan 3	0	0	0	0	0	0	0	0	0	0	0.17	0.17	0.56	0.44	0	0	0	0
	br4	Lace bryozoan 4	0	0	0	0	0	0	0	0	0	0	3.91	1.76	0	0	0	0	0	0
	brf	Lace bryozoan 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0
	bru	Lace bryozoan, unidentified	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0.11	0.1	0.1	0	0
	bryc	Lace bryozoan 8	0	0	0	0	0	0	0	0	0	0	8.7	2.35	0	0	0	0	0	0
Total bryozoans			0		0		0		0		0		14.3		0.67		0.3		0	
Ascidians	wta	White throated ascidian	0	0	0	0	0	0	0.25	0.25	0	0	0	0	1.11	0.65	0.1	0.1	0	0
Molluscs	bra	Ark shell (*Barbatia pistachia*)	0	0	0	0	0	0	0	0	0	0	0	0	0.56	0.44	0	0	0	0
	myt	*Mytilus edulis*	1.5	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinoderms	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0	0	0	0	0	0	0.44	0.43	0	0	0	0
	toa	*Tosia australis*	0	0	0	0	0	0	0	0	0	0	0.17	0.12	0	0	0	0	0	0
Substrate	bre	Bare reef	0	0	0	0	0	0	62.3	11.4	73.3	10.6	36.5	5.09	57.7	7.06	85	2.63	95.6	2.13
	sed	Sediment, usually fine	0	0	0	0	0	0	0	0	0	0	0	0	5.56	5.41	0	0	0	0
Total substrate			0		0		0		62.3		73.3		36.5		63.2		85		95.6	

Table 17. Quantitative estimates of cover vs depth at Little Woody Island Transect 2

		Depth (replicates)	0.5m (5)		1m (1)		2m (4)		3m (2)		5m (12)		10m (14)		12m (6)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	car	*Carpoglossum confluens*	53.2	15.6	8	0	44	19.3	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	9.6	7.36	0	0	11.5	11.5	0	0	0	0	0	0	0	0
	hor	*Hormisira banksii*	10.4	4.79	0	0	0	0	0	0	0	0	0	0	0	0
Algae-green	ulv	*Ulva* spp.	22.8	12.8	52	0	0	0	0	0	0	0	0	0	0	0
Algae-red	fre	Fillamentous reds	3.6	2.23	36	0	0	0	0	0	0	0	0	0	0	0
Total algae			99.6		96		55.5		0		0		0		0	
Cnidarians	sco	Solitary coral	0	0	0	0	0	0	0	0	0	0	0.29	0.29	0	0
	soc	Soft coral	0	0	0	0	0	0	0	0	0	0	0.29	0.19	0	0
Total cnidarians			0		0		0		0		0		0.57		0	
Sponges	sp4	Finger sponge 4, Little Woody Is	0	0	0	0	0	0	0	0	0.33	0.33	0	0	0	0
	spo	Sponge u/i usually flat	0.4	0.4	0	0	0.5	0.5	1	1	0.5	0.26	1	0.46	3.67	1.96
Total sponges			0.4		0		0.5		1		0.83		1		3.67	
Bryozoans	bru	Lace bryozoan, unidentified	0	0	0	0	0	0	0	0	0.83	0.83	0	0	0	0
Ascidians	as2	Ascidian colonial stalked.	0	0	0	0	0	0	0	0	0	0	0.14	0.14	0	0
	wta	White throated ascidian	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Molluscs	myt	*Mytilus edulis*	0	0	6	0	0	0	0	0	0	0	0	0	0	0
	tom	*Tosia magnifica*	0	0	0	0	0	0	0	0	0	0	0.43	0.31	0	0
Other Cover	epi	Fine hydroid/bryozoan layer	0	0	0	0	5	5	0	0	0	0	0	0	0	0
Substrate	bre	Bare reef	2.4	2.4	0	0	39	42.9	98	2	15.3	8.18	0	0	13.7	7.7
	sed	Sediment, usually fine	0	0	0	0	0	0	0	0	83	8.98	98.3	0.46	74.3	11
	uic	Unidentified cover	0.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0
Total substrate			2.8		0		39		98		98.3		98.3		88	

Table 18. Quantitative estimates of cover vs depth at Little Woody Island Transect 3

		Depth (replicates)	0m (4)		1m (5)		2m (14)		5m (17)		7m (12)		8m (13)		10m (4)		12m (1)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	alg	Unidentified algae	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	car	*Carpoglossum confluens*	20	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	80	20	8.57	7.1	0	0	0	0	0	0	0	0	0	0
	hor	*Hormisira banksii*	23	9.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae-green	ulv	Ulva spp.	41	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae-red	enc	Encrusting corralines	0	0	0	0	2.71	2.56	0	0	0	0	0	0	0	0	0	0
	fre	Fillamentous reds	7.5	4.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	tha	*Thamnoclonium dichotomum*	0	0	0	0	12.1	6.81	9.76	3.54	0	0	0	0	0	0	0	0
Total algae			93		80		23.4		9.76		0		0		0		0	
Cnidarians	oct	Common octocoral	0	0	0	0	0	0	0.59	0.59	2	1.54	2.31	1.39	0	0	0	0
	an1	Anemone, pink solitary	0	0	0	0	0	0	0	0	0.3	0.33	0	0	0	0	0	0
	sco	Solitary coral	0	0	0	0	0	0	0	0	0.3	0.33	0	0	0	0	0	0
	soc	Soft coral	0	0	0	0	2.14	1.28	14.2	3.82	0.5	0.36	0.15	0.15	0	0	0	0
Total cnidarians			0	0		0		2.14		14.8		3.2		2.46		0		0
Sponges	fsbc	Finger sponge broad cream	0	0	0	0	0	0	0.24	0.24	0	0	0	0	0	0	0	0
	fso	Finger sponge-orange	0	0	0	0	0	0	8.24	2.26	0	0	0	0	0	0	0	0
	fsw	Finger sponge-white,cf orange	0	0	0	0	0	0	0.71	0.71	0.2	0.17	0	0	0	0	0	0
	jhs	Jokers hat sponge	0	0	0	0	0	0	2.47	0.9	0.8	0.46	0.15	0.15	0	0	0	0
	sp2	Sponge finger, very fine white/grey	0	0	0	0	0	0	1.88	1.29	0	0	0	0	0	0	0	0
	spo	Sponge u/i usually flat	0	0	0.8	0.8	1.29	0.4	4.35	0.99	3.7	0.81	4.77	1.1	0	0	0	0
	ssg	Sponge solid grey	0	0	0	0	0	0	0.59	0.41	0	0	0	0	0	0	0	0
Total sponges			0	0		0.8		1.29		18.5		4.7		4.92		0		0
Bryozoans	br4	Lace bryozoan 4	0	0	0	0	0	0	0.82	0.57	0	0	0	0	0	0	0	0
	brb	Lace bryozoan 7	0	0	0	0	0	0	0	0	0.2	0.17	0	0	0	0	0	0
	brf	Lace bryozoan 5	0	0	0	0	0	0	0.94	0.67	0	0	0	0	0	0	0	0
	bry	Lace bryozoan, unidentified	0	0	0	0	0	0	0.94	0.52	3.2	2.01	1.08	0.66	0	0	0	0
Total bryozoans			0	0		0		0		2.71		3.3		1.08		0		0
Ascidians	asc	Ascidian u/I	0	0	0	0	0	0	0	0	1.5	1.5	0	0	0	0	0	0
	wta	White throated ascidian	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Molluscs	myt	*Mytilus edulis*	0	0	0	0	0	0	0	0	2.2	1	2.46	1.14	0	0	0	0
Annelids	gal	*Galiolaria* sp.	3.5	3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinoderms	gon	*Goniocidaris tubaria*	0	0	0	0	1.43	1.43	0	0	0	0	0.31	0.31	0	0	0	0
	tom	*Tosia magnifica*	0	0	0	0	0	0	0.12	0.12	0.2	0.17	0	0	0	0	0	0
Other Cover	bres	Fine sediment cover on bare reef	0	0	0	0	0	0	0.12	0.12	0.2	0.17	0.31	0.31	1	1	0	0
	epi	Fine hydroid/bryozoan layer	0	0	0	0	48.9	12.3	2.71	2.71	19	10.1	0	0	0	0	0	0
	uic	Unidentified cover	0	0	20	20	0	0	48.8	5.98	33	12.6	92.2	7.35	0	0	0	0
Substrate	bre	Bare reef	0	0	0	0	0	0	4.35	3.08	0	0	0	0	0	0	0	0
	sed	Sediment, usually fine	0	0	20	20	90.1	14.8	51.9	4.47	54	11.6	92.2	7.35	0	0	0	0
	sgr	Sand/gravel	0	0	0	0	3.86	3.86	0	0	26	11.5	4	3.14	99	1	0	0
Total substrate			0		20		94		56.2		79		96.2		99		0	

Table 19. Quantitative estimates of cover vs depth at Joan Point Transect 1

		Depth (replicates)	2m (8)		5m (17)		10m (13)		15m (16)		20m (17)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	eck	*Ecklonia radiata*	16	8.54	0	0	0	0	0	0	0	0
Cnidarians	oct	Common octocoral	0	0	0	0	12.3	4.13	0.38	0.38	1.41	1.41
	an1	Anemone, pink solitary	0	0	0	0	5.23	4.46	2.75	1.63	0	0
	an3	Anemone, elongate pink-white	0	0	0	0	0	0	0	0	8.94	4.82
	sco	Solitary coral	0	0	0	0	0	0	0	0	0.35	0.19
	soc	Soft coral	0	0	49.4	4.53	1.54	1.22	2.25	1.24	1.18	0.69
	yez	Yellow zooanthid	0	0	0	0	0	0	4.13	2.33	0	0
Total cnidarians			0		49.4		19.1		9.5		11.9	
Sponges	cus	Cup sponge	0	0	0.59	0.59	0	0	3.63	1.25	1.18	0.96
	cus2	Cup sponge. Spiral form.	0	0	0	0	0	0	0.25	0.25	0	0
	fso	Finger sponge-orange	0	0	5.65	2.39	0	0	3.25	2.07	0	0
	sp12	Sponge, large grey	0	0	0	0	0	0	2.38	1.31	1.88	1.33
	sp13	Finger sponge, slender white	0	0	0	0	0	0	0	0	0.94	0.94
	spo	Sponge u/i usually flat	0	0	1.06	0.46	1.23	1.08	16.8	3.86	11.1	3.03
Total sponges			0		7.29		1.23		26.3		15.1	
Bryozoans	br6	Branching bryozoan 2	0	0	0	0	0	0	0	0	0	0
	brf	Lace bryozoan 5	0	0	0	0	0	0	0	0	1.65	1.42
	bryc	Lace bryozoan 8	0	0	0	0	0	0	0	0	1.29	1.29
Total bryozoans			0		0		0		0		2.94	
Annelids	gal	Galiolaria sp.	0	0	0	0	0	0	1.13	0.77	0	0
Echinoderms	bas	Basketstar	0	0	0	0	0	0	0	0	0.12	0.12
	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0.13	0.13	0.12	0.12
	hel	*Heliocidaris erytrogramma*	0	0	0	0	3.38	1.95	0	0	0	0
	tom	*Tosia magnifica*	0	0	0	0	0	0	0.13	0.13	0.12	0.12
Other Cover	breb	Fine hydroid/bryozoan layer	0	0	44.5	4.64	64.8	7.63	59.9	5.26	65.8	6.63
	uic	Unidentified cover	0	0	0	0	0	0	2.5	2.5	0	0
Substrate	bre	Bare reef	84	8.54	44.5	4.64	64.8	7.63	59.9	5.26	65.8	6.63
	cob	Cobble	0	0	0	0	0.31	0.31	0	0	0	0
	sed	Sediment, usually fine	0	0	0	0	2.62	1.94	0	0	0	0
	sgr	Sand/gravel	0	0	0	0	9.08	4.54	0	0	0	0
Total substrate			84		44.5		76.8		59.9		65.8	

Table 20. Quantitative estimates of cover vs depth at Joan Point Transect 2

		Depth (replicates)	0m (5)		1m (10)		2m (15)		5m (15)		10m (9)		19m (10)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	eck	*Ecklonia radiata*	0	0	0	0	4.13	3.17	0	0	0	0	0	0
	hor	*Hormisira banksii*	81.2	8.48	0	0	0	0	0	0	0	0	0	0
Algae-green	fgr	Fillamentous greens	0	0	0	0	0.27	0.27	0	0	0	0	0	0
	ulv	*Ulva* sp.	8.8	5.16	0	0	0	0	0	0	0	0	0	0
Algae-red	enc	Encrusting corralines	0	0	0	0	0	0	0.4	0.4	0	0	0	0
	fre	Fillamentous reds	0	0	0	0	0.67	0.67	0	0	0	0	0	0
Total algae			90	0	0	0	0	0	0.4	0	0	0	0	0
Cnidarians	soc	Soft coral	0		0		0		28.5		0		0	
Sponges	sp1	Sponge 1 Joan Pt 15m.	0	0	0	0	0.67	0.67	0	0	0	0	0	0
	spo	Sponge u/i usually flat	0	0	0.8	0.44	4.13	1	3.2	1.12	0	0	0.2	0.2
Total sponges			0		0.8		0		3.2		0		0.2	
Molluscs	myt	*Mytilus edulis*	1.2	0.8	0	0	0.13	0.13	0	0	0	0	0	0
Annelids	gal	*Galiolaria* sp.	0	0	0.2	0.2	0	0	0.13	0.13	0	0	1.4	0.67
Substrate	bre	Bare reef	0	0	99.4	0.43	89.7	3.06	55.5	5.12	0	0	34.2	13.9
	gra	Gravel	0	0	0	0	0	0	1.6	1.6	0	0	0	0
	grs	Gravel with shells	0	0	0	0	0	0	8.8	4.37	100	0	64.2	14.1
	san	Sand	0	0	0	0	0	0	2.4	2.01	0	0	0	0
	sas	Sand/shells	0	0	0	0	0.93	0.93	0	0	0	0	0	0
Total bare substrate			0		99.4		90.6		68.3		100		98.4	

Table 21. Quantitative estimates of cover vs depth at Joan Point Transect 3

		Depth (replicates)	0m (2)		2m (15)		5m (16)		10m (15)		15m (18)		20m (14)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	car	*Carpoglossum confluens*	10	10	0	0	0	0	0	0	0	0	0	0
	eck	*Ecklonia radiata*	0	0	6.27	5.12	0	0	0	0	0	0	0	0
	hor	*Hormisira banksii*	14	6	0	0	0	0	0	0	0	0	0	0
Algae-green	cha	*Chaetomorpha billardierii*	14	14	0	0	0	0	0	0	0	0	0	0
	ulv	*Ulva* spp.	25	1	0	0	0	0	0	0	0	0	0	0
Total algae			63		6.27		0		0		0		0	
Cnidarians	an1	Anemone, pink solitary	0	0	0	0	0	0	0.27	0.27	1.44	1.02	2.86	2.86
	oct	Common octocoral	0	0	0	0	8.63	4.47	0	0	2.67	0.91	3.14	1.1
	sco	Solitary coral	0	0	0	0	0	0	0	0	0	0	0.14	0.14
	soc	Soft coral	0	0	0	0	23.5	6.72	0.8	0.43	0	0	0	0
	hyd	Hydroids	0	0	0	0	0	0	0.13	0.13	0	0	0	0
Total cnidarians			0		0		32.1		1.2		4.11		6.14	
Sponges	sp1	Sponge 1 Joan Pt 15m.	0	0	0	0	0	0	0	0	0.22	0.15	3.29	0.8
	sp2	Sponge finger, very fine white/grey	0	0	0	0	0	0	0	0	0	0	0.43	0.43
	sp3	Finger sponge 3, fine white/grey	0	0	0	0	1.5	1.26	0	0	0	0	0.43	0.43
	sp6	Tube sponge?	0	0	0	0	0.25	0.25	0	0	0	0	0	0
	spo	Sponge u/i usually flat	0	0	5.6	2.03	2.63	0.83	3.33	1.71	2	0.49	1.86	1.14
Total sponges			0		5.6		4.38		3.33		2.22		6	
Bryozoans	br1	Lace bryozoan 1	0	0	0	0	0	0	0	0	0	0	0.14	0.14
	brf	Lace bryozoan 5	0	0	0	0	0	0	0	0	0.33	0.24	0	0
	brg	Lace Bryozoan 6	0	0	0	0	0	0	0.13	0.13	0	0	0	0
	bru	Lace bryozoan, unidentified	0	0	0	0	0.5	0.22	0	0	0	0	0	0
	bryc	Lace bryozoan 8	0	0	0	0	2.75	2.75	0	0	0	0	0	0
Total bryozoans			0		0		3.25		0.13		0.33		0.14	
Ascidians	as1	Ascidian solitary 1	0	0	0	0	0	0	0	0	0.33	0.33	0.14	0.14
	wta	White throated ascidian	0	0	0	0	0	0	0	0	0.33	0.33	0	0
Molluscs	bra	Ark shell (*Barbatia pistachia*)	0	0	0	0	0	0	6.4	2.5	0	0	0	0
Echinoderms	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0	0	0	0	0.29	0.29
	toa	*Tosia australis*	0	0	0	0	0.25	0.25	0	0	0	0	0	0
Substrate	bre	Bare reef	38	38	82.8	8.01	48.8	8.37	74.9	11.6	92.4	7.64	87.6	3.7
	gra	Gravel	0	0	0	0	0	0	0.53	0.53	0	0	0	0
	grs	Gravel with shells	0	0	0	0	12.5	7.22	13.5	8.51	0	0	0	0
	sgr	Sand/gravel	0	0	0	0	0	0	6.67	6.67	0	0	0	0
Total substrate			38		82.8		61.3		95.6		92.4		87.6	

Table 22. Quantitative estimates of cover vs depth at Eve Point Transect 3

		Depth (replicates)	0.5m (4)		1m (5)		2m (14)		5m (16)		10m (18)		15m (17)		20m (20)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	eck	*Ecklonia radiata*	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	hor	*Hormisira banksii*	32	4.83	0	0	0	0	0	0	0	0	0	0	0	0
	ulv	*Ulva* sp.	39.5	2.5	0	0	0	0	0	0	0	0	0	0	0	0
Total algae			71.5	0	0	0	0	0	0	0	0	0	0	0	0	0
Cnidarians	oct	Common octocoral	0	0	0	0	0	0	0	0	6	0.47	1.47	0.28	1.3	0.92
	an1	Anemone, pink solitary	0	0	0	0	0	0	0	0	3.78	0.59	14.4	0.73	4.9	2.23
	oc2	Octocoral species 2, elongate	0	0	0	0	0	0	0	0	0	0	0	0	1.8	1.31
	sco	Solitary coral	0	0	0	0	0	0	0	0	0	0	0.4	0.05	0	0
	soc	Soft coral	0	0	0	0	0	0	48.6	4.88	0	0	11.9	0.73	11.7	1.75
	hyd	Hydroids	0	0	0	0	0	0	0	0	0	0	0	0	7.1	3.3
Total cnidarians			0	0	0	0	0	0	48.6	0	9.78	0	28.1	0	26.8	0
Sponges	sp12	Sponge, large grey	0	0	0	0	0	0	0	0	0	0	0.67	0.15	0	0
	sp20	Sponge massive cream hairy	0	0	0	0	0	0	0	0	0	0	1.6	0.26	0.5	0.5
	spo	Sponge u/i usually flat	0	0	0	0	0	0	1.38	0.6	0.22	0.05	14.5	0.62	12.4	2.09
Total sponges			0	0	0	0	0	0	1.38	0	0.22	0	16.8	0	12.9	0
Bryozoans	bryc	Lace bryozoan 8	0	0	0	0	0	0	0	0	0	0	3.73	0.85	0	0
Ascidians	wta	White throated ascidian	0	0	0	0	0	0	0	0	0.33	0.06	0	0	0	0
	as11	Stalked ascidian solitary	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1
	as7	Colonial ascidian 4 shiny white	0	0	0	0	0	0	0	0	0	0	0.13	0.03	0	0
Molluscs	bra	Ark shell (*Barbatia pistachia*)	0	0	0	0	0	0	0	0	27.2	1.2	0.93	0.18	0	0
	myt	*Mytilus edulis*	11.5	3.86	1.2	0.8	5.43	1.53	0	0	0	0	0	0	0	0
Echinoderms	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0.3
	sti	*Stichopus mollis*	0	0	0	0	0	0	0	0	0.22	0.05	0	0	0	0
	tom	*Tosia magnifica*	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2
Other cover	breb	Fine hydroid/bryozoan layer	0	0	0	0	0	0	0	0	0	0	0	0	9.4	3.29
Cover	bre	Bare reef	16	5.23	98.8	0.8	94.6	1.53	49.8	4.98	58	1	50.3	1.04	57.6	4.24
	grs	Gravel with shells	0	0	0	0	0	0	0	0	4	0.41	0	0	0	0
Total cover			16		98.8		94.6		49.8		62		50.3		57.6	

Table 23. Quantitative estimates of cover vs depth at Eve Point Transect 4

		Depth (replicates)	0.5m (6)		2m (20)		5m (18)		7m (21)		10m (15)		15m (16)		20m (16)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	bro	Brown algae unidentified	10	4.82	0	0	0	0	0	0	0	0	0	0	0	0
	fbr	Fillamentous browns	16.7	6.57	0	0	0	0	0	0	0	0	0	0	0	0
	hor	*Hormisira banksii*	48.3	5.1	0	0	0	0	0	0	0	0	0	0	0	0
Algae-green	ulv	*Ulva* spp.	39	8.29	0	0	0	0	0	0	0	0	0	0	0	0
Total algae			114		0		0		0		0		0		0	
Cnidarians	oct	Common octocoral	0	0	0	0	2.35	2.29	0	0	0.27	0.27	0.88	0.75	1.5	0.85
	an1	Anemone, pink solitary	0	0	0	0	0	0	2.11	1.34	19.9	8.24	0	0	2.88	1.03
	sco	Solitary coral	0	0	0	0	0	0	0	0	0	0	0.25	0.25	0.88	0.41
	soc	Soft coral	0	0	0	0	26.2	4.52	6.11	2.25	0	0	1	0.55	0.5	0.29
Total cnidarians			0		0		28.6		8.2		20.1		2.13		5.76	
Sponges	cus	Cup sponge	0	0	0	0	0	0	0.11	0.1	0	0	0	0	0	0
	sp17	Sponge massive white-grey	0	0	0	0	0	0	0	0	0	0	0	0	0.88	0.88
	sp18	Sponge grey massive	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0.25
	sp19	Sponge cream upright block	0	0	0	0	0	0	0	0	0	0	1.38	0.79	0.5	0.29
	sp20	Sponge massive cream hairy	0	0	0	0	0	0	0	0	0	0	0	0	0.63	0.44
	spo	Sponge u/i usually flat	0	0	2.5	1.83	2.12	0.63	1	0.34	1.07	0.47	3.25	0.85	6	1.55
Total sponges			0		2.5		2.12		1.11		1.07		4.63		8.25	
Bryozoans	br7	Branching bryozoan 2	0	0	0	0	0.47	0.46	2.78	1.24	0	0	0	0	0	0
	brb	Lace bryozoan 7	0	0	0	0	0	0	0.22	0.21	0	0	0	0	0	0
	bry	Lace bryozoan, unidentified	0	0	0	0	0.59	0.57	0.33	0.31	0	0	0	0	0	0
	bryc	Lace bryozoan 8	0	0	0	0	1.65	1.6	11.11	4.57	0	0	0	0	0	0
Total bryozoans			0		0		2.71		14.44		0		0		0	
Ascidians	asc	Ascidian u/I	0	0	2.3	2.3	0	0	0	0	0	0	0	0	0	0
	wta	White throated ascidian	0	0	0	0	0	0	0	0	0.13	0.13	0	0	0	0
Molluscs	bra	Ark shell (*Barbatia pistachia*)	0	0	0	0	2.94	1.63	2	1.36	21.7	5.99	28.5	8.7	2.63	2.15
	myt	*Mytilus edulis*	0.33	0.33	11.9	3.27	0	0	0	0	0	0	0	0	0	0
Annelids	gal	*Galiolaria* sp.	0	0	14.7	5.97	19.5	7.34	29	7.19	0	0	0	0	0	0
Echinoderms	gon	*Goniocidaris tubaria*	0	0	0	0	0	0	0	0	0	0	0.63	0.35	0.25	0.25
	tom	*Tosia magnifica*	0	0	0	0	0	0	0.22	0.21	0	0	0	0	0.13	0.13
Other cover	epi	Fine hydroid/bryozoan layer	0	0	0	0	0	0	0	0	0	0	0.75	0.75	0	0
	uid	Unidentified cover	2.33	2.33	0	0	0	0	0	0	0	0	3	2.08	1.25	1.25
Substrate	bre	Bare reef	3.67	1.82	65.7	5.52	41.8	3.49	44.3	4.64	42.3	6.75	56.1	7.51	79.9	2.21
	gra	Gravel	0	0	0	0	2	1.94	0	0	2.27	2.27	0	0	0	0
	grs	Gravel with shells	0	0	0	0	0.94	0.91	1.67	1.54	10.4	3.83	0	0	1.5	1.04
	san	Sand	0	0	0	0	0	0	0	0	0.27	0.27	0	0	0	0
	sgr	Sand/gravel	0	0	0	0	0	0	0	0	0	0	3.63	2.61	0	0
	she	Shells	0	0	2.9	1.51	1.06	1.03	0	0	1.73	1.73	0	0	0	0
Total substrate			3.67		68.6		45.8		46		56.9		59.8		81.4	

Table 24. Quantitative estimates of cover vs depth at Point East of Eve Point Transect 1

		Depth (replicates)	0.5m (6)		1m (10)		2m (5)		5m (14)		7m (15)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	hor	*Hormisira banksii*	6.33	4.08	0	0	0	0	0	0	0	0
Algae-green	fgr	Fillamentous greens	5.67	4.01	0	0	0	0	0	0	0	0
	ulv	*Ulva* spp.	0.67	0.67	0	0	0	0	0	0	0	0
Total algae			12.7		0		0		0		0	
Sponges	spo	Sponge u/i usually flat	0	0	0	0	0	0	0.71	0.4	0.53	0.36
Molluscs	myt	*Mytilus edulis*	0	0	2.4	5.64	0	0	0	0	0	0
Annelids	gal	*Galiolaria* sp.	0	0	0	0	0	0	5.43	2.61	0.8	0.55
Substrate	bre	Bare reef	57	9.41	75.2	36.4	98.8	1.2	82.3	8.2	20.9	9.88
	grs	Gravel with shells	12	12	7.4	17	0	0	0	0	66.4	12.6
	san	Sand	18.3	10.9	15	31.9	0	0	0	0	0	0
	sed	Sediment, usually fine	0	0	0	0	1.2	1.2	11.4	8.04	11.3	7.86
Total substrate			87.3		97.6		100		93.7		98.7	

Table 25. Quantitative estimates of cover vs depth at Platypus Point Transect 1

		Depth (replicates)	0m (2)		1m (2)		2m (8)		5m (13)		10m (12)		15m (14)		20m (16)		25m (2)	
Cover	Code	Description of species or cover	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
Algae-brown	hor	*Hormisira banksii*	58	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Algae-green	ulv	*Ulva* spp.	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total algae			61		0		0		0		0		0		0		0	
Cnidarians	an1	Anemone, pink solitary	0	0	0	0	0	0	0	0	0.91	0.6	0	0	0	0	0	0
	an3	Anemone, elongate pink-white	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0.25	0	0
	an4	Anemone, elongate pink-white	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0.13	0	0
	sco	Solitary coral	0	0	0	0	0	0	0	0	0.33	0.22	5.57	0.73	4.13	0.29	0	0
	soc	Soft coral	0	0	0	0	0	0	20.2	4.98	0.17	0.17	0	0	0	0	0	0
Total cnidarians	totc		0	0	0	0	0	0	20.2	0	1.41	0	5.57	0	4.5	0	0	0
Sponges	spo	Sponge u/i usually flat	0	0	0	0	0	0	0.77	0.43	0	0	0	0	7.13	5.67	0	0
Total sponges	tots		0	0	0	0	0	0	0.77	0	0	0	0	0	7.13	0	0	0
Bryozoans	br2	Lace bryozoan 2	0	0	0	0	0	0	0.77	0.77	0	0	0	0	0	0	0	0
Total bryozoans	totb		0	0	0	0	0	0	0.77	0	0	0	0	0	0	0	0	0
Molluscs	myt	*Mytilus edulis*	0	0	0	0	34	6.72	0	0	0	0	0	0	0	0	0	0
Annelids	gal	*Galiolaria* sp.	0	0	0	0	2	2	13.7	4.3	0	0	0	0	0.63	0.44	0	0
Cover	uid	Unidentified cover	21	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Substrate	bre	Bare reef	18	14	100	0	64	5.45	48.5	10.4	76.2	11.7	56.3	11.5	87.8	5.62	0	0
	gra	Gravel	0	0	0	0	0	0	0	0	8.33	8.33	0	0	0	0	0	0
	grs	Gravel with shells	0	0	0	0	0	0	23.8	5.69	0	0	0	0	0	0	0	0
	san	Sand	0	0	0	0	0	0	0	0	1.67	1.67	0	0	0	0	0	0
	sed	Sediment, usually fine	0	0	0	0	0	0	0	0	14.2	9.73	38.1	11.4	0	0	100	0
Total substrate	totsub		18	0	100	0	64	0	72.3	0	100	0	94.4	0	87.8	0	100	0

At Sarah Island three transects were completed (Tables 4-6) with varying exposure around the island. The degree of exposure primarily influenced the algal assemblage present at shallower depths with *Durvillaea* extending to 2m at the most exposed site (T2) and being absent at the most sheltered site (T1) where it was replaced by *Xiphophora gladiata* as the most abundant species at 0.5m and by a mix of *Macrocystis pyrifera, Carpoglossum confluens* and *Ecklonia* at 1-2m. Sarah Island was similar to Bramble Cove with respect to the maximum depth of algae, with most algae other than *Thamnoclonium* being restricted to depths of less than 5m by the low light levels. At depths from 5m to 20m Sarah Island was characterised by having the largest diversity of invertebrate species of all the locations surveyed, without any species being particularly abundant and with the majority of the substrate being bare or covered with a fine epifaunal matrix. Notable features include the relatively high total sponge cover from 5-20m (approximately 10%) with cup sponges being a major component, the substantial contribution of seapens (*Sarcoptilis grandis*) (5%) in a sediment patch in 10m on T1 and the presence of two stoloniferous octocorals (bramble corals) that were most abundant at this site relative to adjacent sites. The most common of these is a species of *Acabaria* while the other species appears to be a melithaeid species. Other notable features included the presence of a variety of other cnidarian species including hydroids, seawhips (*Primnoella* sp.), soft corals (*Capnella* sp.), solitary hard corals (*Balanophyllia bairdiana*), yellow zooanthids (*Parazoanthus* sp.) and gorgonian fans (Isidid spp.).

Waterfall Bay, situated on an essentially sheltered shoreline opposite Sarah Island at the seaward end of Bathurst Channel, was primarily surveyed due to the known presence of seapens in the area. The reef here generally extended offshore to approximately 5m depth where it graded to fine silty sediment. The algal assemblage on the reef reflected the sheltered nature of this shore with *Hormisira banksii* and *Ulva sp.* in the intertidal zone grading to *Xiphophora, Ulva, Carpoglossum, Macrocystis* and *Ecklonia* at 1m and to predominantly *Ecklonia, Carpoglossum* and turfing browns at 2m (Tables 7-9). Like Sarah Island, the algae had virtually disappeared by 5m depth with the exception of *Thamnoclonium*. The most notable feature of the reef system was the predominance of soft coral cover (approximately 5%) at 5m. Beyond the reef edge, seapens were not evident on T1 with the exception of a single seapen at 100m offshore. Seapens were more abundant on T2, providing approximately 0.4% cover between depths of 5 to 7m. At T2 an extension reel of 100m length was added to investigate the offshore extension of the seapens. The abundance of seapens in this region was significantly higher than encountered in the first 100m, with cover reaching 2% at 8m depth (Table x). While the data from T3 has not been analysed in detail, seapens were not recorded on the transect, however a few individuals were sighted in the vicinity.

A single transect was completed at Beabey Point, the next site eastwards from Waterfall Bay. Here the macroalgal assemblage was dominated by *Hormosira* in the immediate subtidal area, by *Carpoglossum* and *Macrocystis* at 0.5m, and by *Ecklonia* at 1-2m, with *Macrocystis* also reaching 2m (Table 10). By 5m depth only red algae were present, with *Thamnoclonium* being the dominant species. Algae did not extend beyond 5m. The invertebrates were characterised by a band of mussels (*Mytilus edulis*) at 2m and a concentration of soft coral (approximately 7% cover) at 5m. Other notable features included a moderate cover of tube-worms (*Galiolaria* sp.) at 5m, the presence of seawhips at 5m and solitary corals from 5-15m. The reef margin was at

approximately 17m where the reef graded to fine silty sediment.

The Munday Island and Forrester Point sites are situated directly opposite each other at a substantial constriction within Bathurst Channel where the reef slopes facing the channel tend to have steep slopes and are subject to strong currents. At the Munday Island site two transects were completed (Tables 13 & 14). The algae at these sites was dominated by *Hormisira, Ulva* and *Carpoglossum* at the low tide mark, with *Ecklonia* and *Carpoglossum* extending to 2m. Encrusting corallines were a notable feature at 2m and *Thamnoclonium* extended from 2-5m. Characteristic features of the invertebrate cover included a band of mussels at 0m, an extensive cover of seawhips at 5m (averaging 16%), a moderate sponge cover from 5-20m, lace bryozoans at 15-20m (reaching 1% cover) and a moderate cover of the common octocoral (*Clavularia* sp.) between 5-15m. The seawhips were restricted to a fairly compressed band, with few sighted at 10m or deeper. The abundance of *Clavularia* sp. identified in the still images may be an under-representation of their actual cover as their transparent polyps are difficult to detect against the dark background of sediment overlying the reef in many images used. At Forrester Point three transects were completed with the results from only two being analysed (Tables 11 & 12). The overall assemblage structure there was very similar to that found at Munday Island. *Hormosira* and *Ulva* were abundant at 0.5m, *Carpoglossum* and *Ecklonia* replaced them at 1m, *Ecklonia* was the dominant species at 2m and by 5m the only remaining algae were *Thamnoclonium* and encrusting coralline reds. Seawhips were abundant at 5m (with the exception of T3) and extended in lower numbers to 10 m. The octocoral *Clavularia* sp. was a common feature from 5-15m, and sponges averaged greater than 10% cover between 5-20m where reef was present, with the exception of T3, a site with less current flow than T2 and T1. Of the sponges, cup sponges were particularly abundant between 15-20m where reef was present. At both T1 and T3 the reef graded to fine silty sediment between 15 and 20m, while at T1 the reef extended below 20m. Lace bryozoans contributed approximately 1-2% of the cover between 10-20m on T1 and T2 and were a prominent feature in a depth zone characterised by extensive areas of bare reef with a fine epifaunal/sediment cover.

The next site surveyed eastwards was Little Woody Island where three transects were completed (Tables 15-18). Here the algal assemblage was characterised by *Hormosira* and *Ulva* in the immediate subtidal zone, being increasingly replaced by *Carpoglossum* by 0.5m, with *Carpoglossum* and *Ecklonia* dominant between 1-2m and with most algae absent by 3m. *Thamnoclonium* was the only algae present at 5m, and there it was only present on T3. The invertebrate assemblage had started to replace the algal assemblage by 3m with soft corals being a dominant feature. There was a peak in invertebrate abundance at 5m on T1 and T3 (T2 was primarily sediment by 5m depth). This was characterised by an abundant cover of soft corals (averaging 18%), sponges (averaging 12%) and lace bryozoans (averaging 8%). This was the second highest cover of soft corals and the highest cover of lace bryozoans recorded on the survey. The soft corals were in a fairly defined band from 2m to 8m with a peak at 5m, and were not recorded below this band. The bryozoan distribution was fairly similar, with a substantial peak at 5m that declined significantly by 10m, although they were found in low numbers on reef in 15m where it occurred (T1). At this site the reef generally graded to soft sediments at somewhere between 5 and 16m depending on location. Other notable features included the presence of a band of mussels between 0-1m and a small proportion of ark shells (*Barbatia pistachia*) at 10m on T1 (0.5%) representing

the seaward limit of this species detected by the video analysis. The low diversity of species on T3 reflected the sediment distribution with the reef being primarily covered with sediment at 5m, grading to full sediment cover below.

Joan Point represents the westernmost extent of "The Narrows" section of Bathurst Channel and together with Farrell Point directly opposite, forms a major constriction of the Channel. Three transects were completed at Joan Point (Tables 18-20). The algal assemblage was quite limited at this location, with a restricted band of *Hormosira, Chaetomorpha billardierii, Ulva* and *Carpoglossum* around the immediate subtidal area followed by a bare zone from approximately 0.5 to 1.5m in which no algae or other life-forms were present. This zone was generally covered with a fine layer of silt and presumably represents a region regularly inundated by low-salinity water, with low light availability that limits the possible range of species able to occupy the zone. At 2m there was a small band of *Ecklonia* which did not extend below 3m, and by 5m there were no algae except a small patch of encrusting coralline algae. Soft corals dominated the invertebrate fauna at 5m, representing approximately 34% of the total cover, and while they extended to at least 20m in the area, their peak in abundance was at 5m. The octocoral *Clavularia* sp. was a significant component of the assemblage, however unlike the soft corals, it was found at a range of depths and appeared to be patchily distributed between 5 and 20m. Sponges were also common, reaching a peak in abundance of 26% cover at 15m on T1, and providing an average of approximately 5% cover at 5m. Lace bryozoans were relatively rare, with their peak in abundance on T1 being 3% at 5m, a similar depth to the peak abundance recorded at Little Woody Island. Other notable features included a band of mussels at 0m, and the presence of a moderate cover arc shells at 10m on T3, and a slight cover of tube worms (*Galiolaria* sp.) from 2m to 20m. The site overall was characterised by a distinct peak in invertebrate abundance at 5m in the zone dominated by soft corals, sponges, bryozoans and octocorals (*Clavularia* sp.).

At Eve Point in the mid section of "The Narrows" four transects were completed for reference, but only two (T3 &T4) were analysed in detail due to time constraints (Tables 21 & 22). On these transects, algae was restricted to a small band between 0-0.5m. *Hormosira* and *Ulva* were the only recognisable species present, although fillamentous brown algae and an unidentified species contributed to the algal cover. At one metre the substrate was essentially bare with a light sediment cover, with the exception of patches of mussels occupying the 0.5-2m depth range. Mussels and tube-worms were the predominant cover at 2m, with sponges being a minor component. Soft corals were abundant at 5m, forming approximately 37% of the cover. Like Joan Pt, their peak in abundance was at 5m, however the overall distribution of soft corals extended to at least 20m. On T4, tube worms formed a major component of the overall cover between 2 and 7m, with a peak of 29% at 7m and forming nearly 20% of the cover at 5m. Lace bryozoans were present as a minor component at 5m on T4 and peaked in abundance on that transect at 7m with 14% cover. Other notable components of the assemblage included the octocoral *Clavularia* sp, which was patchily distributed across depths from 5m, a pink solitary anemone that extended from 7-20m and formed a significant proportion of cover between 10-20m, and the arc shell (*Barbatia pistachia*) that formed approximately 25% cover at 10m and an average of 14% cover at 15m, representing a significant component of the assemblage.

The point immediately to the east of Eve Point was surveyed with a single transect to provide additional description of the gradient of assemblages throughout the Channel system (Table 23). At this site the reef extent was relatively limited, extending to approximately 6m depth before grading through gravel and shells to fine silty sediment, a situation typical of the coastline away from the major constrictions where current scour prevents deeper reefs being covered with sediment. *Hormosira* and filamentous green algae between 0-0.5m provided the majority of a sparse algal cover present, with algae being absent at 1m depth and beyond. In general the assemblage was sparse at this site with the most notable features being a small cover of mussels at 1m, tube worms common at 5m, and a very minor contribution of sponges at 5 to 7m.

Platypus Point marks the eastern end of Bathurst Channel and a single transect was surveyed there to match a transect undertaken during a prior study and to complete the description of assemblage change throughout the Channel (Table 24). *Hormosira* and *Ulva* formed the only algal component present, and while they were common at 0m, they did not extend much below this, with no algae present at 1m. At 1m the reef substrate was essentially bare, with only a fine sediment cover on the rocks. At 2m the cover was similar, with the exception of a substantial cover of mussels (34%) and a minor cover of tube-worms. By 5m, soft corals were abundant and formed 20% of the cover with tube worms providing an additional 14%. Below 5m the cover was relatively limited, although solitary corals formed a significant and notable proportion of cover at 15-20m depth (approximately 4%) and sponges were relatively abundant at 20m (7% cover).

3.2 General trends throughout the system

There were a number of clear trends in the distribution of the biotic assemblages throughout Bathurst Channel, and some of the key features are shown in Figs 2-4.

3.2.1 Algae

At the western end of the Channel, sites at Sarah Island, the inner shore of Breaksea Island and Bramble Cove (Millner Head), were subject to greater exposure to swells than any of the sites further east. At these more eastern sites, currents and wind-driven surface waves provided the bulk of water movement. This exposure gradient was particularly evident in the algal assemblage where, for example, the exposed water species *Durvillaea potatorum* was abundant at between 0-2m at the western sites, but was not found east of Sarah Island (Site 4, Fig. 2). The pattern was similar with algal species typically found at moderate exposure (such as *Lessonia corrugata*, *Xiphopora gladiata* and *Macrocystis pyrifera*) that gradually declined in abundance from west to east and were absent after Beabey Point (Tables 2-10), where the degree of exposure becomes low to very low. Correlated with this decline in exposure from west to east was an increase in the abundance of more sheltered water species such as *Hormosira,* and *Ulva*, as well as intermediate species such as *Carpoglossum* (Fig. 2). *Hormosira* and *Ulva* were present throughout the entire sheltered water component of the Channel eastwards of Beabey Point (Site 6), while *Carpoglossum* gradually declined in extent and depth range and was absent eastwards of Joan Point (Site 10, Fig. 2).

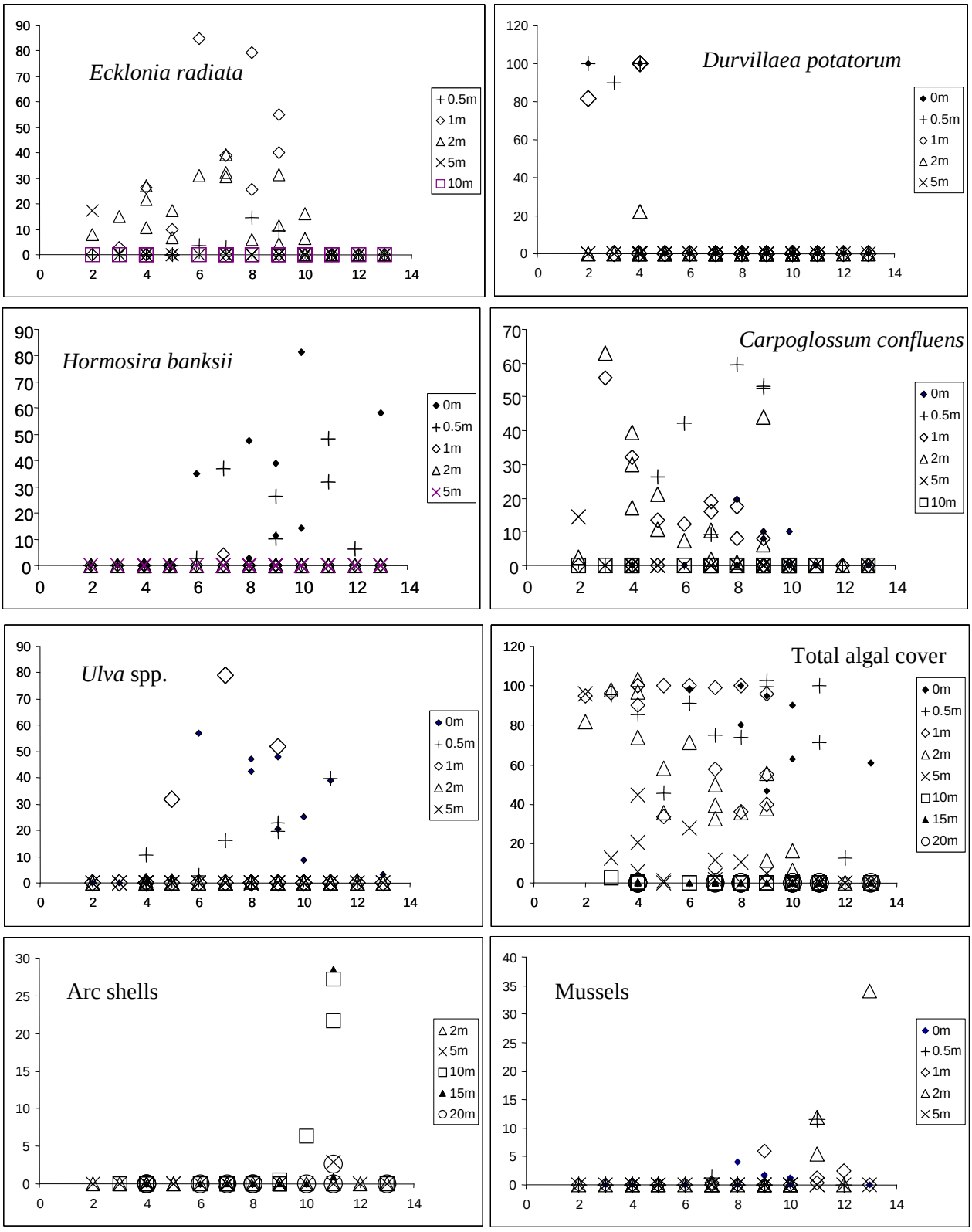

Figure 2. Mean percentage cover of algal and mollusc species by depth identified from sites in Bathurst Channel and the surrounding coastline surveyed by quantitative video-quadrats in October/November 2002. Some sites have multiple transects and not all depths were surveyed at each site (see tables 2-25 for depths surveyed on each transect at each site). Site numbers correspond to site codes in Table 1. They range from seaward at Breaksea Island to Platypus Point at the eastern end of Bathurst Channel.

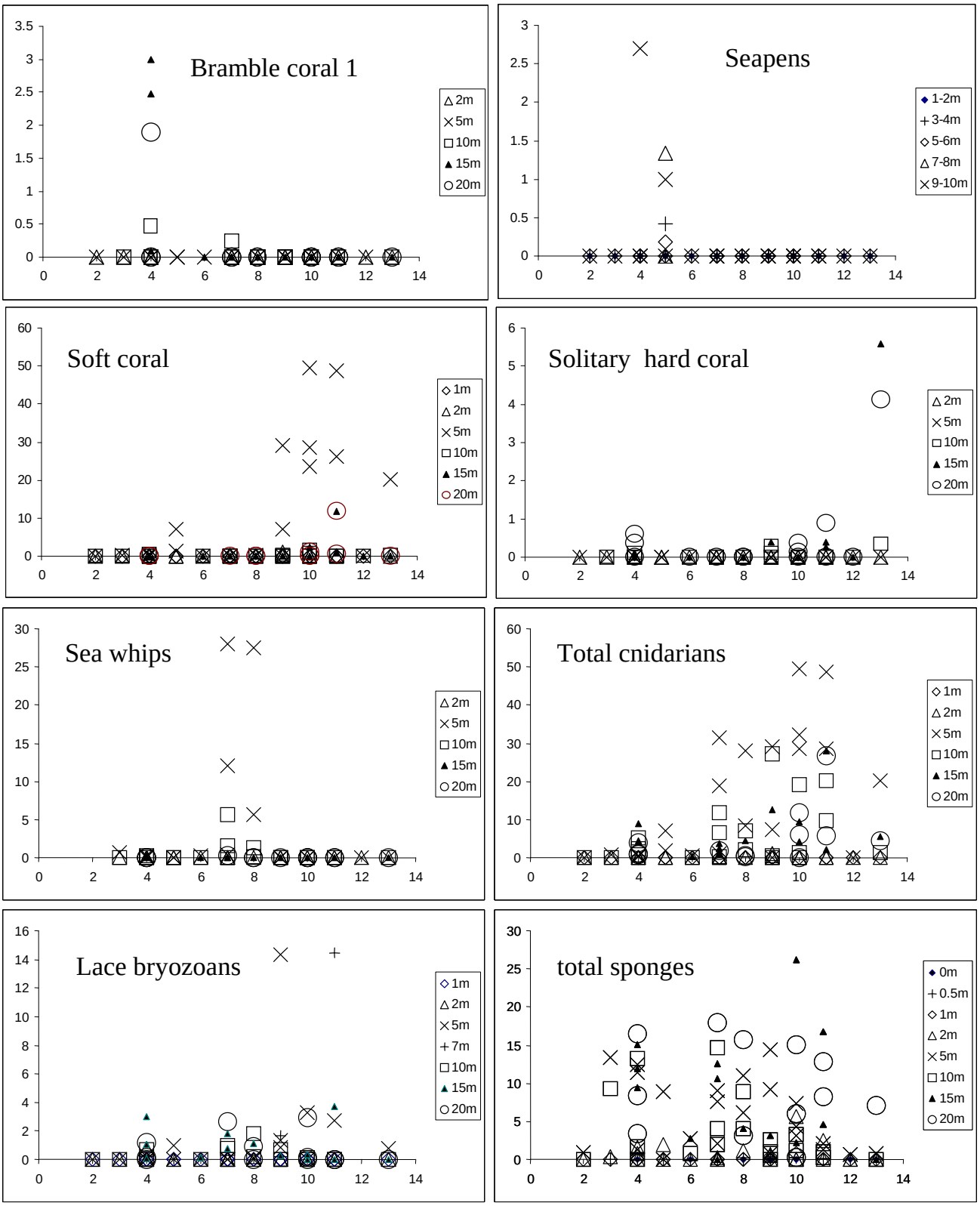

Figure 3. Mean percentage cover of invertebrate species by depth identified from sites in Bathurst channel and the surrounding coastline surveyed by quantitative video-quadrats in October/November 2002. Some sites have multiple transects and not all depths were surveyed at each site (see tables 2-25 for depths surveyed on each transect at each site). Site numbers correspond to site codes in Table 1. They range from seaward at Breaksea Island to Platypus Point at the eastern end of Bathurst Channel.

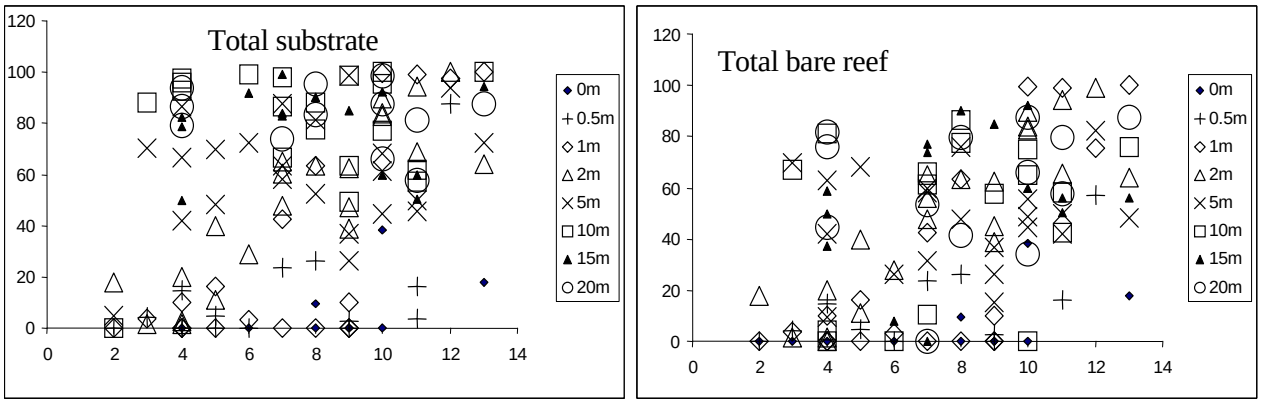

Figure 4. Mean percentage cover of bare substrate by depth identified from sites in Bathurst Channel and the surrounding coastline surveyed by quantitative video-quadrats in October/November 2002. Some sites have multiple transects and not all depths were surveyed at each site (see tables 2-25 for depths surveyed on each transect at each site). Site numbers correspond to site codes in Table 1. They range from seaward at Breaksea Island to Platypus Point at the eastern end of Bathurst Channel.

A notable feature of the algal assemblage was the compression of the depth range that species occurred over in Bathurst Channel, and the distinct gradient in the degree of compression of the algal assemblage throughout this system. This is presumably in response to the influence of gradients in exposure, light availability (due to strengthening tannin coloration), salinity and nutrients from west to east. At the western end of the system, on the inner shore of Breaksea Island, the total algal cover from 0-5m was nearly 100%, (Fig. 2) and included a range of typical exposed water species (including *Phyllospora comosa*) (Table 2), albeit in a compressed vertical succession relative to similar sites on the outer section of Port Davey not subject to light limitation by tannin stained water. Eastwards of Breaksea Island the extent of algal cover at the lower depths declined rapidly, with the average algal cover at 5m reducing to 25% by Sarah Island. Here at 5m brown algae were replaced by red algal species capable of surviving under low light conditions, predominantly *Thamnoclonium* (due to its commensal sponge association) and encrusting corallines. Moving further along the gradient, no algae were present at 5m eastwards of Little Woody Island, they contracted above 2m eastwards of Joan Point, and contracted above 0.5m eastwards of the point immediately east of Eve Point (Fig. 2), with the only macroalgal species remaining (*Hormisira* and *Ulva*), being restricted to a narrow band immediately below the intertidal zone.

One notable feature of this gradient in depth distribution, was the absence of algae or any other form of cover at Joan Point within the 0.5-1.5m depth zone. Below this barren zone there was an additional algal zone with limited cover (including *Ecklonia*) at 2m. This disjunct distribution is presumably related to differing salinity tolerances of the algal species present interacting with light tolerance, with the freshwater tolerant species *Hormisira* and *Ulva* being restricted to the upper zone by light availability in this strongly tannin stained section of the Channel, and the freshwater intolerant species such as *Ecklonia* being restricted to a narrow band where light is still sufficient for photosynthesis and salinity changes associated with rainfall events are not fatal.

3.2.2 Invertebrates

Like the algal assemblage, the invertebrate assemblage displayed considerable clinal variation from west to east throughout the Bathurst Channel system (Fig. 3). At Breaksea Island, on the inner shore, invertebrates only made a small contribution to the overall cover (Table 2, Fig. 3), with the reef only extending to approximately 7m depth at the site surveyed and with algae dominating the cover to the reef margin. The overall invertebrate cover increased in an easterly direction by Bramble Cove (Millner head) where sponges had become equally as abundant as the algal cover at 5m, particularly the conspicuous cup sponges. This cover increased again by Sarah Island where stronger tannin levels lead to a further reduction in canopy forming algal cover and depth penetration, resulting in less competition for space with filter-feeding invertebrates. Sarah Island marked the western end of the invertebrate dominated zone, and while the total cover of invertebrates was not as high here as a number of sites further to the east, it did appear to have the highest diversity of conspicuous invertebrate species. These included lace bryozoans, seawhips, seapens, soft corals, solitary corals, yellow zooanthids and a variety of sponges. To the east of Sarah Island the increasing cover of invertebrates mirrored the decline in algal cover, with a range of invertebrates, particularly dominated by cnidarians (including soft corals and seawhips) replacing algae at the 5m depth contour. There was less replacement at depths shallower than 5m, with this depth range tending to have an increasing component of bare reef rather than an increasing invertebrate component. The exception to this was the cover of mussels that predominantly extended from Little Woody Island to Platypus Point as a substantial component within the 0-2m depth range, potentially due to the ability of mussels to tolerate periods of low salinity. Many of the invertebrates within the system were fully marine species and presumably would not be able to live in the upper few metres that can become highly stratified in the mid to eastern sections of the channel during rainfall events. At depths below 5m, the invertebrate assemblage was free from algal competition throughout the estuary and there was no clear pattern other than species replacement along the system, and a marked decline in the abundance of most species at the upper end. The decline at the upper end of the system was evident across the entire depth range, particularly at the point east of Eve Point and at Platypus Point and included sponges, lace bryozoans and cnidarians (Fig. 3). This pattern may partly represent decreased current flow (and therefore food availability) at the point east of Eve Point as well as the limited depth range found there, however the Platypus Point site was in a constricted area with strong current flow adjacent to the deep channel, and trends apparent there would be in response to the major gradient forming processes operating throughout the system.

The most notable feature of the invertebrate assemblage in Bathurst Channel was the distribution and transition of species throughout the estuary. At the seaward end the assemblages were characterised by cup sponges and the diversity of species, with no group being particularly dominant. Sarah Island was relatively unique in that it was the main location where the two species of stoloniferous octocorals (the bramble corals *Acabaria* sp. and a Melithaeid sp.) were found and were conspicuous components of the assemblage (Fig. 3). Likewise it was the only location where gorgonian fans (Isidid spp.) were common (Table 3), and with the possible exception of a few vagrants, both bramble corals and gorgonian fans did not extend further eastwards than Forrester Point. The large seapens (*Sarcoptilis grandis*) were also most abundant at Sarah Island,

and although they were also quite numerous at Waterfall Bay, their distribution was restricted to this small section of the estuary (Fig 3).

The next stage in the species succession throughout the estuary was evident at Forrester Point and Munday Island, where seawhips completely dominated the invertebrate assemblage at 5m, and extended as a significant component to at least 10m. The seawhip zone was relatively restricted in geographical distribution, with no seawhips being detected further eastwards, and with seawhips only contribution a minor component of the fauna westwards at Sarah Island. This section of the channel also represented the peak in sponge cover within the system. Unlike the seawhips, the overall distribution of sponges was generally widespread through the system at depths below the algal zone, with this distribution cutting off sharply at both ends of the system, presumably due to the low productivity and food availability at the upper end of the system, and competition with algae at the lower end of the system. Cup sponges, a distinctive and representative component of the sponge assemblage in Bathurst Channel, also reached a peak in abundance within this zone (Tables 2-20).

Moving further to the east, lace bryozoans, soft corals and arc shells formed a distinctive zone that ranged from Little Woody Island to Eve Point (Figs. 2 &3). Although both soft corals and lace bryozoans were broadly distributed throughout the estuary, there was a distinct peak in their distribution within this area. Soft corals formed the most conspicuous component, providing up to 50% of the total cover at 5m at Eve Point and Joan Point, with their distribution strongly centred about the 5m depth contour. Lace bryozoans were less abundant than soft corals, however they still formed a significant component of the cover in this zone, reaching up to 14% at optimal depths at Little Woody Island and Joan Point. Like the soft corals, there was a distinct peak in their distribution near the 5m depth contour (7m at Eve Point), although they were also present at most depths surveyed below the algal zone. Unlike the soft corals and bryozoans, arc shells appeared to be entirely restricted to this zone, forming a significant proportion of the cover at 10 and 15m at Eve Point and a moderate cover at 10m at Joan Point. They were also present at Little Woody Island, but averaged less than 0.3% cover there at 10m. Like the soft corals and bryozoans, they had a fairly restricted depth distribution, with the vast majority of sightings being in the 10 and 15m depth categories (Fig. 2).

The final zone within the estuary, extending eastwards from immediately past Eve Point to the eastern end of Bathurst Channel at Platypus point, was characterised as being a relatively depauperate and low diversity zone with most groups (other than soft corals, solitary hard corals and mussels) being either absent or low in abundance. Sponges formed a minor cover, but at Platypus Point this was restricted to the lower depths around 10m. The most notable features were the continuing presence of soft and hard corals at Platypus Point, with both species being conspicuous components of the assemblage at their preferred depths at this site. As soft corals still formed a significant proportion of the cover at 5m (20%) this area could be considered a low diversity extension of the soft coral zone of the estuary. Solitary hard corals were relatively abundant at Platypus Point between 15-20 metres, and were significantly more abundant at this site than any other site surveyed, although their overall distribution ranged throughout the estuary from Sarah Island. Mussels showed a similar pattern at the shallower end of the depth range, being abundant at 2m, although their distribution

in the estuary was more restricted than the solitary hard corals, extending seaward only as far as Forrester Point as a conspicuous component of the faunal assemblage. Presumably the upper limit of mussels is regulated at Platypus Point by the prevalence of freshwater in the surface layers.

3.2.3 Overall cover

Like the algal and invertebrate cover, there were clear trends in the extent of bare substrate and bare reef throughout the system. These two components are separated in Fig. 4 to allow clearer interpretation of trends relating to biological processes from those relating to substrate variability from site to site. For example the absence of a significant biological component may relate more to a particular location having a greater proportion of gravel (an unstable habitat) rather than to another factor such as lack of current flow, or low salinity. One of the clearest trends was for the deeper sections of the reef to have significantly less cover than shallower sections. The amount of bare substrate at 15 to 20m averaged between 80-100% throughout the system (Fig. 4), and related to approximately an equivalent of 60-80% bare reef, with the difference being due to the relatively high gravel and patchy sediment cover on the reef area at these depths. The significant difference in the proportion of cover between deep and shallow reefs was primarily related to the extensive algal cover on shallow reef at the western to middle sections of the estuary, and to the high cover of soft corals at 5m in the middle section of the estuary. At the eastern end, the pattern was reversed, with the significant influence of freshwater in the surface layers limiting the proportion of biological cover there, particularly at the 1m level.

At sheltered locations and/or at depth in the western to mid section of the channel, reefs below the algal zone had a variable cover of epifaunal hydroids, bryozoans and other life-forms that formed a filamentous matrix bound with sediment. This cover was at around 100% of all “bare” reef in this zone but was difficult to quantify from the still images used, particularly due to the fine nature of the structures, the dark sediment within the matrix, and the highly variable sediment component. As a general pattern, the cover of this layer (referred to as “fine hydroid/bryozoan layer” in the tables) reduced significantly between Joan and Eve Points and was essentially replaced by a fine sediment layer east of Joan Point.

3.3 Habitat mapping

The bathymetric and benthic habitat survey work undertaken in this study extended from the western to eastern ends of Bathurst Channel, with a slight extension at each end to facilitate accurate description of the bathymetry in these areas. While it was initially proposed to extend this work to include Bramble Cove, weather conditions limited the time available for mapping, resulting on the need to focus on the core area of interest. The outputs from this work are essentially a series of ARCINFO GIS layers that can be represented as maps at a range of scales. The core habitat maps presented here (Figs 5-7) were produced at a scale of 1:35000 as a compromise between the visibility of minor features and the need for simplicity in the number of maps produced. The two additional maps (Figs 8 & 9) were produced to show habitats and bathymetry

at a finer scale in the Joe Page Bay area in response to the need to better define this region given current interest in this zone being the turning and anchoring area for cruise ships that are not permitted further eastwards. The bathymetry on these maps (Figs 5-9) not surprisingly, shows features similar to the existing navigation charts, including a relatively narrow central channel that is usually between 20-45m deep mid channel, 300m wide (including the channel slopes up to 10m depth), and that is surrounded in the broader sections of the estuary by relatively extensive "flats" that extend into the many bays within the Channel. The vast majority of the substrate surveyed within the Channel was essentially silt, grading to silty sand, particularly on the channel "flats" and within the sheltered bays. The second most abundant category of substrate was "hard sand" (Figs 5-8) particularly within "The Narrows", however this category is related to the strength of the return signal rather than the presence of sand, and indicates the presence of low flat hard features such as shells or gravel embedded within the sediment. Video inspections of several areas returning the "hard sand" pattern were used to validate this, with the substrate in the areas inspected consisting of shells and gravel within a fine sediment matrix.

The next most common substrate type was "rubble", with this category including a range of rock sizes from gravel to pebbles/cobble and grading to patchy reef. This category was most evident in the sheltered section of the estuary, often in shallow areas with low gradient where wave action provides some degree of sorting. It was also present in some deeper sections of the channel, presumably due to scouring of finer sediments by currents. The extent of reef within the Bathurst Channel system was quite limited, with the only areas with notable reef development being restricted to the western end where exposure to waves and swells maintains the bedrock free from covering sediments, and localised points of constriction within the Channel where high current flows prevent sediment from accumulating. At the western end, an extensive area of reef extended to depths of up to 40m adjacent to Sarah Island on the exposed shore where there is a deep section of Channel nearby, and a more limited fringing reef extends to depths of 5m along the Waterfall Bay to Beabey Point coastline where exposure is minimal and where the coastline adjoins the channel "flats". At points of constriction within the Channel such as Munday Island to Forrester Point, Joan Point to Farrell Point or adjacent to Eve Point, the strong currents often maintained the reef relatively free of covering sediments to depths approaching that of the adjacent channel floor. In some areas, this current scoured reef extended across the entire channel. This was the case at Eve Point, where an extensive area of deeper reef was located (Fig. 7), and was probably the case from the SW corner of Munday Island to Forrester Point (Fig. 5). While this connection is not indicated on the map on the Forrester Point side, dive surveys of the area suggest this would probably be the case.

The absence (within Figs 5-7) of reef immediately adjacent to the shoreline in some areas subject to prevailing winds was often an artefact of the proximity to the shoreline with which it was safe to navigate the survey vessel. In many cases the vessel was not able to operate within a 5-10m distance from the shoreline, and the presence of reef inshore from this was interpolated from the presence of offshore reef. In areas where the reef reached its maximum offshore extent within this range (often 5m or less) it was not detected or mapped. Some areas where this is the case are known from dive surveys. These include much of the western shore of Forrester Point, the southern to eastern shore of Munday Island, and the southern shore of Little Woody Island. As these

represent important habitat for some of the more unique fauna within the Channel, their presence needs to be noted and at some future stage these areas should be targeted for a more focussed survey during optimal weather conditions.

To aid reader interpretation of the habitat types within Bathurst Channel, short embedded video clips have been included in Appendix D in the CD/DVD attached to this report. These clips are spatially related to habitat maps and show habitat variation throughout the Channel as well as with depth.

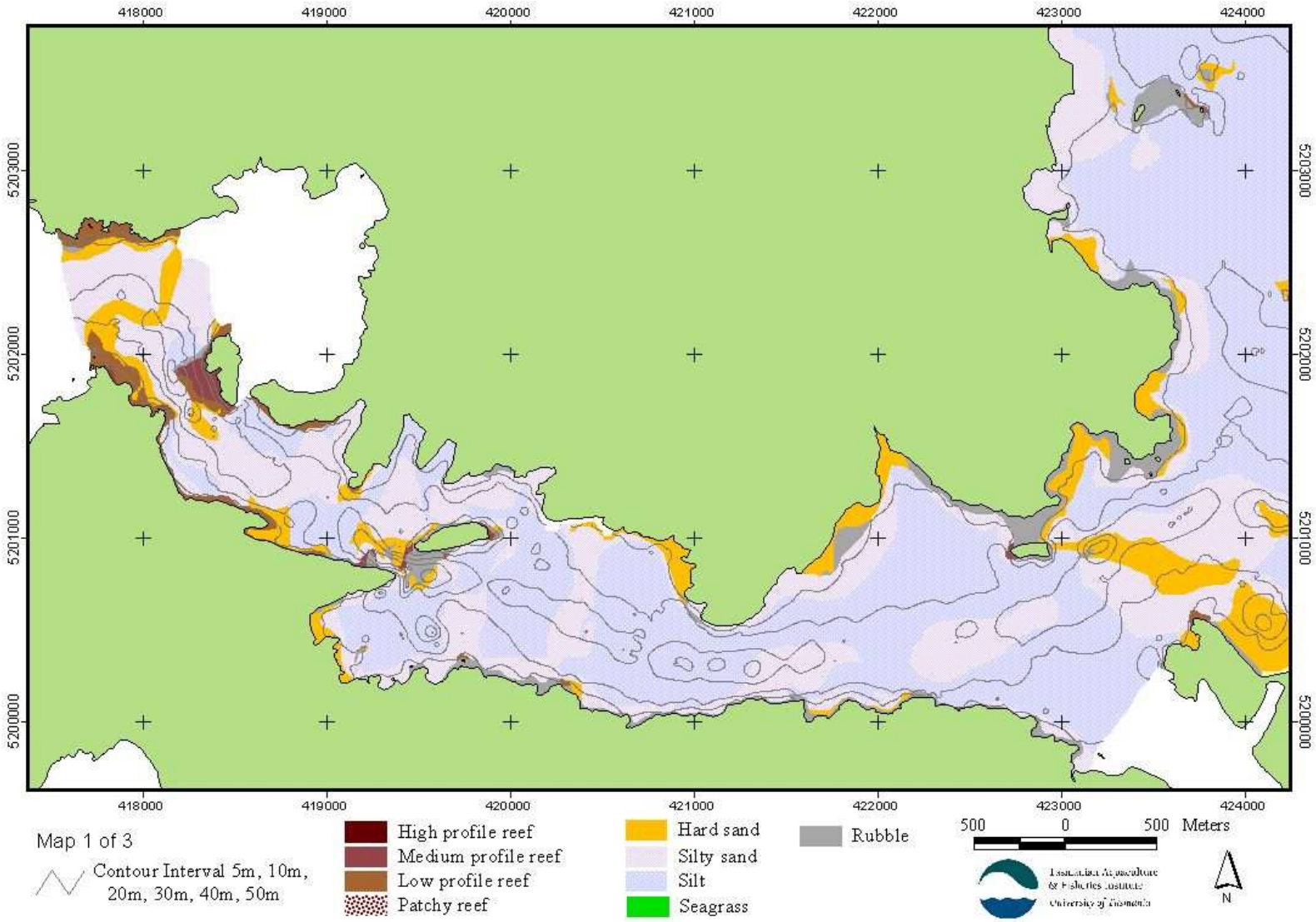

Figure 5. Marine habitat map of the section of Bathurst Channel extending from Bramble Cove to Joe Page Bay.

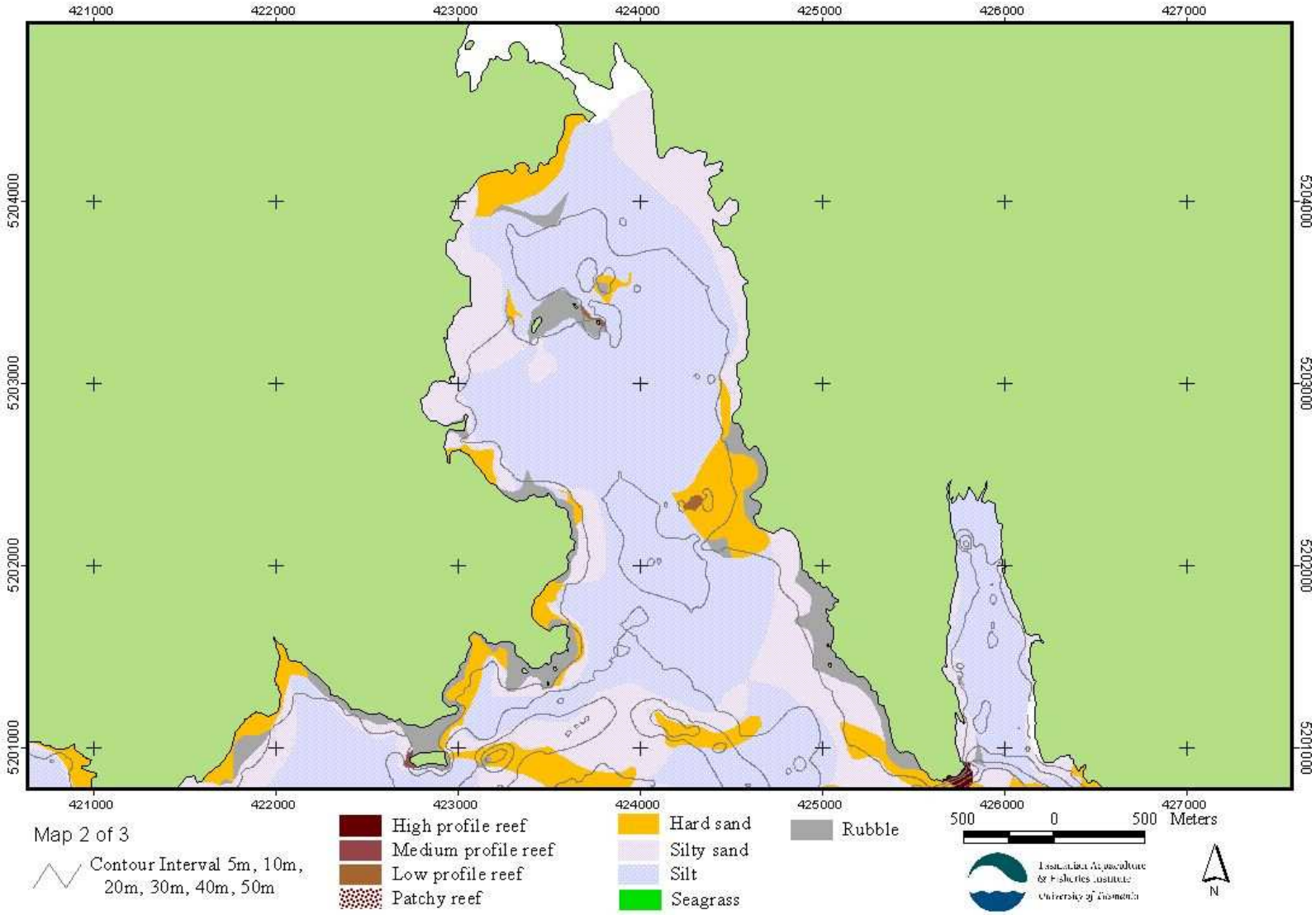

Figure 6. Marine habitat map of the Joe Page Bay section of Bathurst Channel.

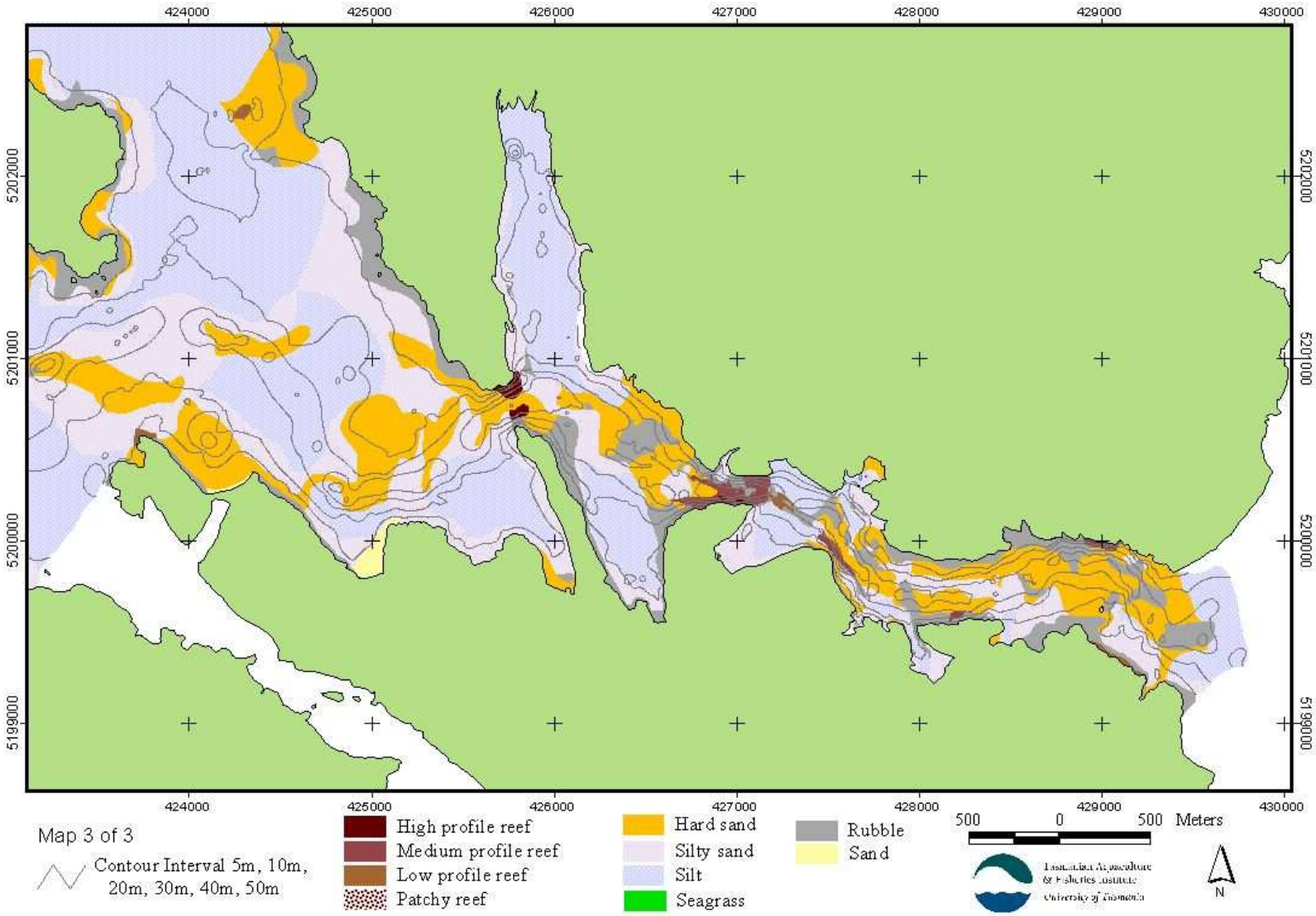

Figure 7. Marine habitat map of the section of Bathurst Channel extending Joe Page Bay to Bathurst Harbour.

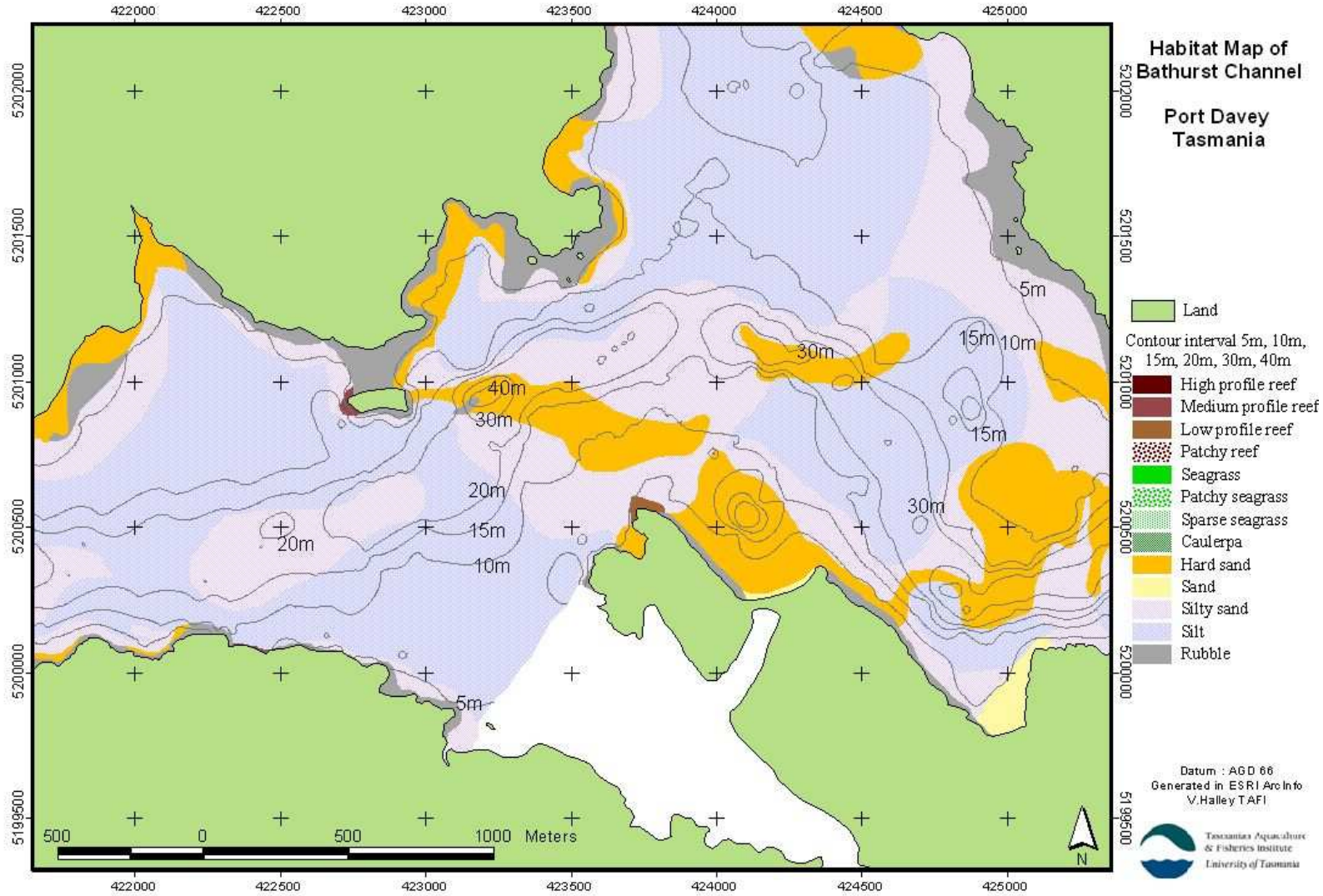

Figure 8. Detailed marine habitat map of the southern section of Joe Page Bay to give an indication of the habitats and bathymetry in the zone identified for Cruise ship turning and anchoring.

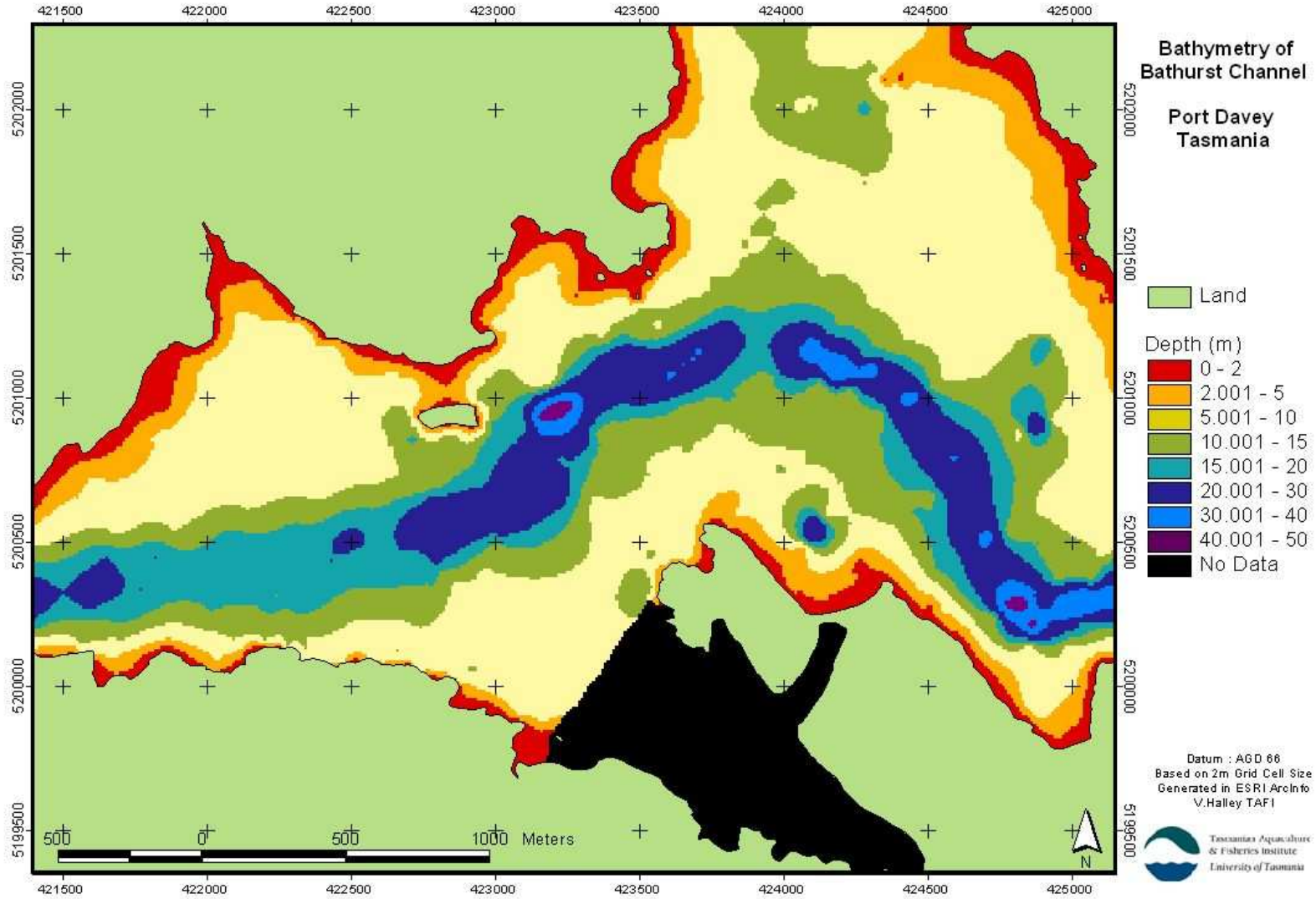

Figure 9. Detailed bathymetry of the southern section of Joe Page Bay identified for Cruise ship turning and anchoring.

Formal description of the assemblages found on the habitats/substrate types mapped was not a component of this study, however there were several notable features. The reef assemblages have been described in detail in the previous section of the results and in previous reports (e.g. Last and Edgar 1994). The rubble habitats were often relatively devoid of characteristic life-forms due to the unstable nature of this substrate, although larger and more stable components had similar cover to reef at equivalent depths. The "hard sand" habitat often had a biotic component that was somewhat similar to the adjacent soft sediments due to the relatively high sediment:shell/gravel ratio of substrates that produced this characteristic acoustic signal. On soft substrates, there was evidence of significant sub-surface biological activity in many areas, characterised by the presence of numerous burrows and raised mounds covering much of the surface layer in the shallower parts of the estuary. In deeper waters (approximately 20-45m) there was less evidence of biological activity in these sediments, with broad areas of the sediment surface being relatively undisturbed. Tube anemones were present on soft sediments throughout the estuary and over all depth ranges, although their density appeared highest at locations with good current flow.

4. Discussion

This survey has provided a quantitative description of the horizontal and vertical distribution of biotic assemblages within the Bathurst Channel section of the Port Davey to Bathurst Harbour estuarine system. It essentially confirms patterns described in previous reports (Edgar 1984, Edgar 1990, Last and Edgar 1994, Barrett *et al.* 1998), and extends them by providing a sound quantitative basis for comparison of variability within sites, between sites, between depths and between years. While the qualitative description of Last and Edgar (1994) (containing limited quantitative data from a restricted set of sites and depths) provided a good indication of patterns, it was not an effective baseline for documenting future changes or impacts within this area, particularly those in some of the rarer and more sensitive assemblages targeted in the present study.

4.1 Zonation within the system

The study confirmed the presence of several distinct zones within the estuary that correlate with strong environmental gradients occurring throughout the system. The biological attributes of each zone are discussed in detail in the results section. The environmental gradients causing this structure include the degree of exposure to waves and swells, light availability due to the strength of influence of overlying tannin stained waters, availability of planktonic food sources, changes in salinity and changes in the availability of nutrients. At the seaward end of the system there is a distinct marine zone (the marine zone- extending eastwards to approximately Beabey Point), characterised by the highest diversity of species and by a moderate restriction of the photic zone. Here the photic zone extended to between 5-10m although by 5m the algal cover was substantially reduced and dominated by red algal species that are more tolerant of low light conditions than brown algae. This compares with the outer part of Port Davey in Saddle Bight where, in clear coastal waters the photic zone is not restricted and brown

algae form 100% cover down to at least 10m (Barrett *et al.* 1998). Signature species within the marine zone include seapens, and two species of stoloniferous octocorals that are restricted to this section of the estuary. The primary determinants of species distribution in this section of the system appear to be exposure and light availability for the algal component, and a mix of high food availability, currents and competition with algae for the invertebrate component. The invertebrate assemblage is dominated by filter-feeding invertebrates, hence the importance of planktonic food and current strength.

At the next zone in the system (eastwards of Beabey Point towards Little Woody Island) seawhips are the dominant feature, and define the zone (the seawhip zone). The lower light conditions in this zone, resulting from increasing influence of tannin surface waters allows them to occupy the 5m depth contour, an area otherwise occupied by algae under higher light regimes. These same low light conditions result in a contraction of the main algal zone to above 5m, and the decrease in exposure relative to the marine zone results in a change from exposed water species to more sheltered water species. Below the 5m depth contour the loss of many species associated with the marine zone is presumably related to decreasing food availability in response to increasing distance from the more productive marine zone, and the vertical migration of plankton towards the surface layers in response to the limited light availability. The characteristic feature of this estuarine system is the overall low productivity of the estuary relative to typical estuarine systems that tend to be more productive in their mid zone than the seaward zone due to higher nutrient availability (Edgar 1990). The low productivity of the Bathurst Harbour/Channel system primarily relates to the uniquely low levels of nutrients entering the system via rivers within the catchment, as a result of the low nutrient and weathering resistant rock type present there. An additional cause of this low productivity is likely to be the highly tannin stained waters within the system that severely restrict light penetration and must therefore likewise limit the zone available for primary production.

At the third zone in the system (Little Woody Island to Eve Point), the seawhips are replaced by soft corals, lace bryozoans and arc shells (the bryozoan/soft coral zone), and the algae contract back to around the 2m depth contour. The algal contraction here is partly related to light availability being further restricted due to increasing tannin levels, but also appears to be in response to decreasing salinity, as a large area within the 1m depth zone is bare of most forms of life except mussels, presumably to the inability of *Ecklonia* to tolerate decreased salinity and the inability of more tolerant species such as *Hormosira* or *Ulva* to be productive at the lower light levels found there.

The factors influencing the invertebrate assemblage in this zone relative to adjacent zones may be more complex than those structuring the algal assemblages. The largest change relative to the adjacent seawhip zone was at around 5m depth where the seawhips were replaced by soft corals and lace bryozoans. This may be due to lower food (plankton) availability in this section of the estuary, with seawhips being less tolerant to lower food levels than the soft corals or lace bryozoans. Alternatively the seawhips may be less tolerant of the salinity changes that occur in this section of the estuary. Edgar (1990) reported salinities as low as 20 parts per thousand at 5m depth in this zone during spring 1988, and presumably during large flood events the salinity may be even lower, with potential consequences for marine species intolerant of low salinity.

Salinity appears to at least be important in regulating the upper limit of invertebrate distribution in this zone, as few invertebrates (with the notable exception of mussels and tube worms) were found at depths above 3m despite the decreased competition from algae. The 5m depth contour appears to be a compromise between the upper salinity tolerance of many filter-feeding species and the availability of plankton that presumably are concentrated in the upper photic layers.

At depths below 5m salinity changes are less likely to be an important component structuring the assemblage, as stratification of the water column prevents significant dilution of marine waters below 6m (Edgar 1990). Despite this, there was a significant differentiation in the biota of this depth range between this and adjacent zones, with arc shells forming an extensive cover at 10m in this zone but being virtually absent in adjacent zones, and with the total cover of cnidarians reaching a peak in abundance. There are many factors that could explain this distribution, including the almost complete absence of light at these depths, further declines in food availability relative to the seaward zones, and increasing levels of sedimentation on the reefs. Light levels are presumably important for species such as the arc shell, not just due to the competition with algal species, but also due to the importance of light to predators. Diurnal fish species such as wrasse play a key role in limiting bivalve mollusc abundance in similar depths in clear water, yet they are completely absent from this section of the estuary. Sedimentation is presumably also an important structuring component as not all filter-feeding species can cope with high levels of sediment.

In the final zone of the Channel system (eastwards of Joan Point), the assemblage was characterised by its relatively low diversity and total cover of species (the low diversity zone). Presumably the mix of low nutrients, high tannin levels (and corresponding low light levels), decreased salinity, and low plankton availability were all contributing factors here, with the algal assemblage contracting above 1m and losing *Ecklonia*, and with the cover of most invertebrate groups including sponges declining markedly. Soft coral was the dominant species, and was still moderately abundant at 5m, proving its ability to tolerate periods of low salinity. In this section of the estuary Edgar (1990) recorded salinities below 15 parts per thousand in spring, a level presumably not able to be tolerated for extended periods by most marine species. Below this zone, in the fully marine waters at 15-20m, hard corals were more abundant than at any other section of the system, and at approximately 5% cover, provided the majority of cover at these depths. Presumably this relates to the relative ability of this species to tolerate the low food availability and high sediment cover on these habitats.

The zonation of the estuarine biotic assemblages obviously continues from Bathurst Channel into Bathurst Harbour, and seaward into the outer section of Port Davey. While these areas were not surveyed during this study, limited quantitative counts have been undertaken on a number of associated studies including Edgar and Last (1994) in Port Davey and Bathurst Harbour, Edgar *et al.* (1995) in Port Davey and along the adjacent coastline, Barrett *et al.* (1998) within Port Davey, including Bond Bay and Bramble Cove, and during a recent, and as yet unpublished survey of Port Davey and adjacent coast by TAFI in 2004. Within Bathurst Harbour itself, the maximum depth is between 6-8m, so reef development is restricted to a maximum of 6m, and in much of the Harbour it is significantly less than this, with the remaining substrate being soft sediments. At the western end of the Harbour, at the Celery Top

Islands, a quantitative transect survey at 5m depth (the depth with maximum cover at Platypus Point, the nearest adjacent site in Bathurst Channel) searching 200m^2 of the seafloor, found that ascidians were the only species present, contributing 0.1% to the total cover, with the rest being bare sediment covered reef. It is predicted that the remaining reefs within the Harbour would be similar, with only a very minor cover of invertebrate species. This is due to the combination of low food availability, low salinity and high sediment cover on the reefs. Edgar (1990) recorded salinities as low as 15 parts per thousand at 6m in the Harbour, with this dropping to 9-10 parts per thousand at 2m depth, presumably too low for many marine species to tolerate.

Overall this study has provided further documentation of the fauna of Bathurst Channel and its distinctive zonation, first identified during studies by Edgar (1990) and further investigated by studies reported in Last and Edgar (1994). This fauna is dominated by deep-water species and is unique within the entire coastal zone of Australia. It is predominantly due to the strong influence of tannin stained surface waters that reduce light penetration to very low levels immediately below the surface, inhibiting algal growth and therefore competition with sessile invertebrates. The only approximate equivalent assemblage is found in Fjordland, New Zealand, where a similar occurrence of strongly tannin stained waters in coastal estuarine systems results in a constricted photic zone and dominance of species such as black corals, seapens and brachiopods in depths of less than 15m (Schiel and Hickford, 2001). Despite superficial similarity, it is possible that the Bathurst Channel assemblage differs considerably from the New Zealand counterparts due to localised characteristics such as the exceptionally low nutrient and productivity levels found in Bathurst Harbour/Channel, and the strong current flow through Bathurst Channel, features that may not occur elsewhere and appear to substantially influence the biological variability within this system. The biogeographical isolation of locations with similar features to Bathurst Channel is likely to result in a high degree of endemism. This is typified by the presence of endemic species on isolated seamounts (e.g. deForges *et al.* 2001), endemic black coral in New Zealand Fjords (Miller 1997, Schiel and Hickford 2001) and the endemic Port Davey Skate in Bathurst Harbour (Last and Stephens 1994). Furthering our understanding of the extent of endemism in the Bathurst Channel/Harbour fauna is a high priority for future assessment of the conservation values of this area and to build upon the value of the baseline dataset established in this study.

4.2 Limitations of video survey methods

The primary aim of the study was to quantify the abundance of species within the unique assemblages of Bathurst Channel at a set of key locations within this area identified during previous studies in 1993 (Edgar and Last 1994), and 1994 (unpublished) including Eve Point, Little Woody Island, Munday Island, Sarah Island and Seapen habitat in Waterfall Bay. Due to the need to describe the distribution of species over a range of depths at each location, and the limited time available for this work, video transects and video quadrats were the chosen method. This method was particularly successful in obtaining the required information within the available time, and with an appropriate degree of replication to adequately quantify the overall cover of individual species for future comparison. Like all methods however, the results do need to be interpreted within the limitations of the methodology used. One limitation of this study was our inability to photograph a 0.5m x 0.5m quadrat placed on the seafloor due

to light-path problems associated with working in tannin-stained waters, most notably in shallow waters in the upper to mid section of the system where tannin levels were particularly high. This is not a major limitation as we were working in percentage cover which is a term not scaled to size, however it meant absolute counts of individual species such as seastars could not be made. Ideally it would be rectified in future studies by using a wider angle lens on the video housing to reduce the distance to the quadrat. Another limitation was that dark objects, including sediment covered objects could not be readily identified against the background reef, as it was often also covered in dark sediment. This may have been particularly the case for species such as arc shells that are quite well camouflaged by their sediment cover and dark colour, and black hydroids that are also particularly difficult to detect. A similar situation exists with transparent organisms such as the common octocoral *Clavularia sp*., a species found throughout the system but probably substantially underestimated at many locations. Particularly small animals, including the filamentous hydroids and associated species were very difficult to detect, especially as they are often entwined and bound up in a sediment matrix. The cover of this "association" of species, listed in the tables as filamentous hydroids/bryozoans was potentially overestimated in many locations due to their similarity with overlying sediment cover. The final limitation is that many species or growth forms could not be clearly differentiated from the video or stills taken from the video and were simply described by their characteristic forms and coloration (e.g. orange finger sponges), potentially leading to an over-estimation of the number of groups such as structural sponges and lace bryozoans due to the conservative approach taken to comparisons. As the analysis is done after the video is taken there is no opportunity to collect species in question for further identification, unlike a conventional dive survey. Reference photographs were taken of each species however, allowing them (and the data presented here) to be more adequately described and grouped in future identification of species.

For non-reef areas, such as the seapen habitat on soft sediments in Waterfall Bay, the video transect method provides a good indication of the distribution and extent of seapens, however due to the relatively low density of seapens in most areas, abundance estimates would be more reliable if larger areas were able to be searched. Ideally this would involve undertaking replicate transect counts (e.g. a 50m x 10m search area per transect) randomly at a range of depths at each site. As the seapens retract below the surface during slack and outgoing tides, this also needs to be allowed for. A search at low tide will often reveal a significantly lower number of seapens within core habitat than a search during a strong incoming tide, thus surveys for this species need to allow for this.

With the exception of the estimation of seapen and other soft sediment species densities, the limitations of the video methodology are generally minor and do not limit the value of this method for describing patterns and changes by direct comparison of results between years. However, because of the fragile and unique nature of the species present at some locations and depths within those locations, it would also be beneficial to incorporate an additional focussed survey in such areas, including a more detailed identification of individual species *in situ*, and collection of representative species for identification where they can't be identified in the field.

4.3 Habitat mapping

The habit mapping undertaken during this study revealed the limited extent of reef habitats within the Bathurst Channel system, with most reef being associated with the exposed western shore of Sarah Island where a mix of swells and currents maintain reefs free from sediment, and at Joan Point and Eve Point where strong currents associated with the channel constriction at the narrows prevent sediment from settling. The limited extent of reef at many of the other locations within the Channel system and its close association with proximity to the main channel highlights the vulnerability of the unique biotic assemblages they support. This may be particularly the case if dive tourism was to expand within the region and focus on locations such as Little Woody Island for example, where fragile lace bryozoans form a significant component of the overall cover at 5m, but where the available habitat is very restricted.

Soft sediments dominated the vast majority of the estuarine system and displayed marked differences between shallow and deep zones, and between eastern and western sections of Bathurst Channel in the extent of bioturbation of the surface layer. There is little information available on the infaunal assemblage that causes this bioturbation and ideally future studies would focus on identifying the key infaunal species and their patterns of distribution within the system. While the extent of available habitats makes such assemblages of species less vulnerable to many forms of disturbance than the reef associated species, they may nevertheless be vulnerable to broadscale influences such as nutrient enhancement and description of these assemblages should be a priority project for baseline assessment within the new marine reserve.

4.4 Baseline data preservation

To ensure that the work undertaken during this survey would be available as a permanently accessible and verifiably baseline, the original videos obtained from transects (and the still images sourced from them as photoquadrats) have been backed up in multiple electronic copies (as MPEG files on DVD) and archived at TAFI to ensure continuity with future studies. The processed data has been entered onto the TAFI Marine Environment database, providing a permanent record for future use.

4.5 Summary and recommendations

This study has successfully established a quantitative baseline dataset on the horizontal and vertical distribution of invertebrate and algal assemblages within Bathurst Channel for use in on-going monitoring of change in the system. Robust estimates of the abundance of most conspicuous species have been obtained at selected sensitive sites allowing future changes and impacts to be detected and quantified. In a combination of comprehensive quantitative surveys throughout the system and detailed habitat mapping, our understanding of the biological zonation within the system has been enhanced along with our understanding of the limited extent of habitat available to many of the unique invertebrate assemblages. Specific recommendations arising from this study include:

1. the need to ensure baseline monitoring continues at an appropriate time-frame (perhaps every five years)
2. the need to build on weaknesses identified during the analysis (such as targeted identification of key species in vulnerable locations)
3. the need to gain a much more detailed understanding of the faunal assemblages that occur within the soft sediment habitats that form the vast majority of cover within Bathurst Channel.

A further recommendation is to facilitate identification of the many unknown and possibly undescribed species found on reefs within Bathurst Channel. While a detailed collection of invertebrates was undertaken by the South Australian Museum during the 1993 study (Last and Edgar 1994), resulting in the identification of a selected component of the fauna, there has been no documented follow-up work, yet this information is essential for conservation value assessment and planning and the planning and implementation of follow-up surveys to target faunal gaps and the distribution of species of particular interest.

5. Acknowledgements

This project was initiated by Michael Driessen (World Heritage Area Zoologist) in response to concerns about the potential impacts of increasing visitation levels in Bathurst channel. The project was funded by the South-West World Heritage Area Steering committee, with in-kind support being provided by TAFI, including the use of Challenger. We wish to thank the Crew of Challenger (Matthew Francis and Jac Gibson) for their usual excellent support during field operations, to Bob Connell for dive support, and Colin Buxton (TAFI Director) for supporting the project.

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